PN-ACD-545
99361

Delivery Order #30
Energy Efficiency in the Industry of Ukraine
November, 1997

REPORT ON ENERGY AUDIT AT LVIV BAKERY # 1,

Lviv City, UKRAINE

Prepared by Mr Bill Dries
Mr Vladimir Mamalyga
Mr Dmitry Kramarenko

Prepared for United States Agency for Independent Development
Washington, D C 20523-1415

Burns and Roe Enterprises, Inc
1400 K Street N W Suite 1050, Washington, D C 20005
Telephone 202-408-6831, Facsimile 202 408 6835

-1-

Table of Contents

1 EXECUTIVE SUMMARY **3**

1 1 INTRODUCTION 3
1 2 BASIC CONCLUSIONS 4
1 3 RECOMMENDATIONS 4
1 4 OPERATION AND ENERGY MANAGEMENT 6

2 GENERAL BACKGROUND **7**

3 ASSESSMENT OF PRODUCTION AND FINANCIAL STATUS OF ENTERPRISE **8**

4 ENERGY RESOURCE CONSUMPTION AND PURCHASE COSTS **15**

4 1 INFORMATION ON THE ENERGY RESOURCE CONSUMPTION 15
4 2 TARIFFS FOR GAS, ELECTRICITY AND WATER 15

5 ENERGY RESOURCE CONSUMPTION BALANCE **19**

5 1 BALANCE OF ELECTRIC POWER CONSUMPTION 19
5 2 GAS CONSUMPTION BALANCE 20
5 3 WATER CONSUMPTION BALANCE 21

6 PREVIOUS STUDIES IN THE AREA OF ENERGY SAVING **22**

7 ENERGY AUDIT **23**

7 1 INTRODUCTION OF ENERGY MANAGEMENT 24
7 2 ENERGY CONSERVATION MEASURES AT THE COMPRESSOR STATIONS 27
7 2 1 General information *27*
7 2 2 Electric motor load level study *28*
7 2 3 Study of the feasibility of the application of controlled electric drives for the compressor engines *29*
7 2 4 Investigation of the possibility of simultaneous utilization of the old (operational) and new (stand-by) compressor stations *35*
7 2 5 Introduction of a system maintaining the constant outlet pressure of the old compressor station *35*
7 3 ENERGY SAVING MEASURES IN THE FTL-2 BAKERY OVENS 36
7 3 1 General information *36*
7 3 2 Improvement of thermal insulation of the FTL-2 bakery ovens *37*
7 3 3 Control of steam supply to FTL-2 bakery oven *38*
7 4 IMPROVEMENT OF THE OPERATION EFFICIENCY OF *E 1 6-0 9* BOILERS IN LVIV BAKERY #1 BOILER-HOUSE 39
7 4 1 General information *39*
7 4 2 Improvement of the thermal insulation of the boilers *40*
7 4 3 Utilisation of the heat of the combustion products leaving E-1,6-1,9 *Boiler* *41*

8 ENVIRONMENTAL IMPACT OF THE RECOMMENDED MEASURES **43**

APPENDICES

A ENERGY CONSERVATION OPPORTUNITIES (ECOs)
B MEASURED AND COLLECTED DATA
C PHOTOGRAPHS OF THE PLANT
D CONVERSION FACTORS
E ABBREVIATIONS

1 EXECUTIVE SUMMARY

1 1 Introduction

According to Contract for Delivery Order #30 ***USAID*** has funded the energy audits of 24 industrial enterprises selected on ***USAID*** criteria to implement the "Energy efficiency of Ukraine industry" project

This report contains the conclusions of the energy audit conducted by the company ***Burns & Roe Enterprises, Inc*** at *Lviv Bakery #1*

In accordance with the sub-task of this Contract, 24 enterprises out of 90 potential ones have been selected for audit Each enterprise has been considered from the point of view of project participants selection criteria (approved by ***USAID***) Such selection criteria included the following long-term economic development forecast, financial status of an enterprise, export revenue share, relation of the present product output to the maximum possible one, energy saving potential, the possibility to extrapolate the project on similar enterprises and enterprise's availability as demonstration site for other enterprises

The bakery's problems related to the energy efficiency are typical for other bakeries of Ukraine

The objectives of energy audits are as follows

- Informal training to energy management practices
- Delivering of energy management goals to the management of enterprises
- Development of specific measures to improve the energy efficiency, including management activities, no cost/low cost measures and selection of the equipment for their implementation
- Recommendations of investment possibilities and medium cost measures focused on the large-scale energy saving

Energy auditing team consisted of

- Mr Bill Dries, USAID team leader,
- Mr Vladimir Mamalyga, Electric Engineer and Economic Analysis Expert,
- Mr Hassan Mustafayev, Gas Engineer,
- Mr Dmitriy Kramarenko, Thermal and Processing Engineer,
- Vladimir Shestopal, Driver,
- Ms Anastasya Leonova, Interpreter/Translator

The audit was performed at the Bakery from 17 till 22 November 1997 In accordance with the objectives of the project, the team has prepared the given report It was translated by Mrs Irina Semibratskay and Mr Valery Gool

1 2 Basic conclusions

- Lviv Bakery #1 is financially in good condition and has a good market for its products
- *64 9* per cent of the total energy resources cost is the cost of gas the larger amount of which (*68* per cent) is consumed for baking bread, baked goods and dry bread *30* per cent of gas is consumed by the boiler-house The total cost of the drinking water (*17 71* per cent) and the sewage cost (*1 49* per cent) exceed the electric power cost (*15 81* per cent) At the same time the basic electric power consumer is the compressor station (*51* per cent of the total consumption by the bakery) The energy consumption balances gained as a result of the energy audit identified the main areas for improvement the efficiency of energy utilization
- The group of energy auditors has identified several quite promising opportunities to improve the energy efficiency at the enterprise
- Despite a repeated rising of the energy prices their portion in the production cost structure is not more than *6 49* per cent The enterprise top management is more interested in purchasing new, more productive processing equipment in lieu of decreasing the use of energy resources However, as the goal of the project is energy utilization efficiency, purchasing a new processing equipment with the resources financed for buying equipment is impossible unless the new equipment reduces energy use and costs
- Lack of an automatic system for controlling the steam supply into the bread baking oven FTL-2 leads to a significant overconsumption of steam (*300* kg of steam/*170* kg of steam = *1 76* relative units = *176* per cent)
- Lack of a system for supporting a stable outlet pressure of the compressor station accounts for an overconsumption of compressed air, and, therefore, an overconsumption of the electric power for its production
- A significant decrease in the electric power and gas consumption would be provided at the enterprise by introduction there of an energy monitoring and management system
- Installation of a heat exchanger to use the boiler exhaust gases would enable to decrease consumption of gas and produce hot water for the district heating system and other purposes

1 3 Recommendations

Table 1 1 below shows a list of possible energy conservation opportunities (ECOs) They are arranged in order of importance for the enterprise The given recommendations will improve the efficiency of the energy resources utilization at the enterprise as well as its competitive capabilities From the point of view of purchasing equipment, due to the mind of the energy auditors team, the following should be bought a combustion analyzer, an infra-red thermometer, some equipment to support constant the outlet pressure of the old compressor station, as well as some equipment for controlling the steam supply into the bread baking ovens FTL-2 The issue of implementation of the other energy saving measures should be settled on the basis of taking into consideration the priorities of development and financial opportunities of the enterprise

Table 1 1

Table 1 1

Energy conservation opportunities (ECOs)

#	Description	Electric power saving, kW h	Natural gas saving, m³	Yearly saving, USD	Measure costs, USD	Payback period, yr	Item in this report
1	Introduction of energy management service	50,000	105,000	$13,260	$13,000	0 98	7 1
2	Controlling supply of steam into *FTL-2* Baking Oven - for one oven - for **13** ovens	 0 0	 106,000 1,378,000	 $8,700 $113,100	 $5,000 $65,000	 0 57 0 57	 7 3 3 7 3 3
3	Improvement of thermal insulation of *FTL-2* Bread Ovens - for one oven - for **13** ovens	 0 0	 5,500 71,500	 $450 $5,850	 $283 $283	 0 63 0 63	 7 3 2 7 3 2
4	Improvement of thermal insulation of the boilers - for one boiler - for four boilers	 0 0	 725 1,450	 $60 $120	 $100 $400	 1 67 3 33	 7 4 2 7 4 2
5	Installation thermal heat exchangers to utilize the heat from the combustion products leaving the boiler - for one boiler - for four boilers	 0 0	 32,400 64,800	 $2,660 $5,320	 $5,100 $20,400	 1 92 3 84	 7 4 3 7 4 3
6	System for sustaining constant outlet pressure at the old compressor station	50,000	0	$2,100	$1,950	0 93	7 2 5
7	Use of a speed-controlled electric motor for the compressor engines	171,600	0	$7,200	$30,000	4 17	7 2 3

Items 1 and 4 are to be implemented with funds from USAID for the equipment, the installation and operation are by the plant people

1 4 Operation and energy management

It is typical for industrial plant management to mainly think in terms of production, and to want to increase its output Therefore it is sometimes difficult to think of the importance of energy and energy costs on the operation of the plant

For *Lviv Bakery #1*, as with most industries in Ukraine, in the past the energy costs were significantly subsidized, therefore energy saving was not a major consideration in the plant operations

With the rising energy costs during the past few years, the energy costs have now become very influential part of the expenses

Most industries in Ukraine have a person or persons who are referred to as energy engineers These people are typically responsible for ensuring that there is an adequate supply of energy to the plant, not to improve the energy efficiency of the plant But with the rise in energy prices and the uncertainty of availability of all fuels, an energy manager to conserve energy becomes important Each plant should seriously consider establishing an energy manager position as a minimum, and for large industries, possibly even an energy management section

These people should be regularly monitoring all operations, and especially reviewing monthly energy consumption These monthly data should be graphed and compared to previous months and years to determine any variations in consumption Where variations do occur, they should then determine the cause of the variation and if remedial action is required For instance, if monthly consumption increases, the reasons why should be determined and if appropriate, steps taken to correct any problem

In addition, the energy management staff should also review each process, and look for energy saving opportunities They should see that all cost effective energy improvements are implemented, beginning with items identified in this energy audit They should then also have responsibility to review all proposed changes to the facility to ensure that each process is as energy efficient as possible

A plant the size of *Lviv Bakery #1* should have one or two persons working in an energy management group It is desirable that these employees were specialists in thermal engineering (gas supply and gas utilizing systems, hot water supply systems, heating equipment, fuel- and heat using equipment, etc) in electrical power engineering (transformers, electric motors, electric drives, etc) The energy manager(s) should report directly to the top management of a plant

At many facilities the energy management section is assigned an energy goal, such as "reducing the overall energy usage by *3* to *5* per cent year" While the percentage goal can vary, this type of challenge gives a benchmark by which the section can be evaluated And in industries in Ukraine, where energy efficiency is just at its infancy, the percentage goal could even be higher Some industries also have an incentive program, in which employees are encouraged to submit energy efficiency improvement ideas These ideas, if accepted and implemented, would result in a small reward being given to the employee

2 GENERAL BACKGROUND

Name Open Joint-Stock Company "Lviv Bakery #1
Address 168 Gorodotska Str , Lviv, Ukraine

General Director Mikhailo Dmytrovych Nechipurenko
Tel/fax (0322)-62-17-43
Chief Engineer Olexandr Ihnatovych Ihnatenko
Tel (0322)-62-17-36

The enterprise was built in 1908 and named "Mercury" at that time
At present the Lviv Bakery produces the following products

- sorts of moulded bread and bread baked in the hearth,
- rolls and buns,
- rusk crumbs,
- dried bread
- bread soft drink (kvas)

Taking into account the 16 specialised shops the enterprise has 655 employees

FTL-2 gas ovens bake bread in the bread shop In confectionery shop two *FTL-20* gas ovens are used to bake the rolls and buns There was one *KS-100* air heater in operation in the rusk shop to dry rusk crumbs

The plant does not export its products

The plant does not engage in barter transactions, the products are sold for cash The present and future market is good The bakery supplies goods to local shops, the army and prisons

3 ASSESSMENT OF PRODUCTION AND FINANCIAL STATUS OF ENTERPRISE

The products produced by enterprise are sold for cash The enterprise makes profit

Table 3 1 shows the product output data from October 1996 to October 1997 inclusive

According to Table 3 1 the curves of monthly product output (see Figure 3 1) by product types (shops or process plants) have been plotted The same curve shows the time dependence of total product output at the enterprise for the same period

The analysis of the curves presented in Figure 3 1 shows that the production appears to be very seasonable So, the difference product output in January and July is UAH ***386 4*** thousand (**$*208,865***) or ***36 5***% (UAH ***386 4*** thousand/***1,059 2*** thousand = ***36 5***%)

Such difference can be mainly explained by critical increase in the product output of the rusk shop in July 1997 As the products of the rusk shop are ordered from time to time (randomly), taking into account the average monthly production level of the rusk shop (UAH ***46 6*** thousand = **$*25,189***) the July production level of UAH ***1,142 8*** thousand (**$*617,730***) can be obtained In this case the seasonal prevalence is not very obvious the difference does not exceed UAH ***244 8*** thousand (**$*132,324***) or ***23 1***%

Figure 3 2 shows the average monthly value of product output obtained according to the data of Table 3 1 - 3 2

As can be seen from Figure 3 2, the products of the bread shop (***83 6***%) equipped with FTL-2 ovens have the highest cost Much less products are produced in the confectionery workshop (***39 1***%) and the rusk shop (***4 4***%) produce much less products Such conclusions can be proved by Table 3 2 data where the information on the cost and profitability of individual products is presented

Figure 3 3 presents the distribution of product cost by product types Figure 3 4 does the distribution of the prime cost, and Figure 4 5 does the distribution of enterprise profit by product types

The analysis of the profitability of individual product, as it is seen in Fig 3 2, shows that the most attractive in this respect are the products of the rusk shop (***18 56***% of profitability) as well as the products of the bread shop (the main products of the bakery) Their profitability is ***17 5***% The products of the confectionery shop are almost by 1/3 less profitable (**11 85%**) The biscuit production profitability (***15 9%***) almost corresponds to the average profitability level (***16 77***%) The production of macaroni foods is low-efficient (profitability is ***6 1***%) The lower profitability of the confectionery shop products proves, apparently, the improper selection of products it would be expedient to produce more expensive rolls and buns if the market exists In this respect it can be recommended to the management to review the range of confectionery shop products

Table 3 1

Lviv Bakery #1 Product Output Data

Shop (product type)	October 1996 th UAH / $ 10³	November 1996 th UAH / $ 10³	December 1996 th UAH / $ 10³	January 1997 th UAH / $ 10³	February 1997 th UAH / $ 10³	March 1997 th UAH / $ 10³	April 1997 th UAH / $ 10³	May 1997 th UAH / $ 10³	June 1997 th UAH / $ 10³	July 1997 th UAH / $ 10³	August 1997 th UAH / $ 10³	September 1997 th UAH / $ 10³	October 1997 th UAH / $ 10³	Total for 13 months th UAH / $ 10³	Average monthly value th UAH / $ 10³
Bread shop (6 types of moulded and hearth-baked bread) FTL-2 gas ovens	956 6 / $517 1	905 3 / $489 4	882 5 / $477 0	750 0 / $405 4	871 1 / $470 9	976 9 / $528 1	859 4 / $464 5	845 1 / $456 8	839 7 / $453 9	972 6 / $525 7	875 2 / $473 1	884 7 / $478 2	897 2 / $485 0	11516 3 / $6225 0	885 9 / $478 9
Confectionery shop *FTL-20* gas ovens (rolls and buns)	110 2 / $59 6	127 3 / $68 81	126 8 / $68 5	112 9 / $61 0	29 2 / $15 8	33 2 / $17 9	90 8 / $49 1	91 5 / $49 5	104 2 / $58 0	99 1 / $53 6	107 8 / $58 3	116 2 / $62 8	104 5 / $56 5	1253 7 / $677 7	96 4 / $52 1
KEP-400 electric oven (rolls and buns)	12 7 / $6 9	14 6 / $7 9	10 9 / $5 9	7 6 / $4 1	13 5 / $7 3	15 0 / $8 1	12 5 / $6 8	9 1 / $4 9	13 5 / $7 3	18 1 / $9 8	19 6 / $10 6	19 4 / $10 5	19 0 / $10 3	155 5 / $84 1	12 0 / $6 5
BEO biscuit machines	19 4 / $10 5	–	29 5 / $14 0	–	2 6 / $1 4	8 9 / $4 8	12 6 / $6 8	31 1 / $16 8	32 2 / $17 4	5 3 / $2 9	7 6 / $4 1	26 3 / $14 2	39 3 / $21 2	211 2 / $114 2	16 2 / $8 8
Rusk shop (rusks)	38 9 / $21 0	57 5 / $31 1	63 1 / $34 1	26 0 / $14 1	3 1 / $1 7	11 6 / $6 3	10 4 / $5 6	28 7 / $15 5	40 0 / $21 6	188 2 / $101 7	52 9 / $28 6	31 9 / $17 2	53 6 / $29 0	605 9 / $327 5	46 6 / $25 2
Macaroni products	4 6 / $2 5	4 8 / $2 6	–	1 5 / $0 8	3 2 / $1 7	2 5 / $1 4	2 0 / $1 1	0 7 / $0 38	–	1 1 / $0 6	5 7 / $3 1	1 3 / $0 7	–	27 4 / $14 8	2 1 / $1 1
Total	**1,142 4 / $617 5**	**1,109 5 / $599 7**	**1,109 1 / $599 0**	**898 0 / $485 4**	**922 7 / $498 8**	**1,048 1 / $566 5**	**987 7 / $533 9**	**1,006 2 / $543 9**	**1,029 6 / $556 5**	**1,284 4 / $694 3**	**1,068 8 / $577 7**	**1,079 8 / $583 7**	**1,113 6 / $601 9**	**13,770 / $7443 2**	**1,059 2 / $572 5**

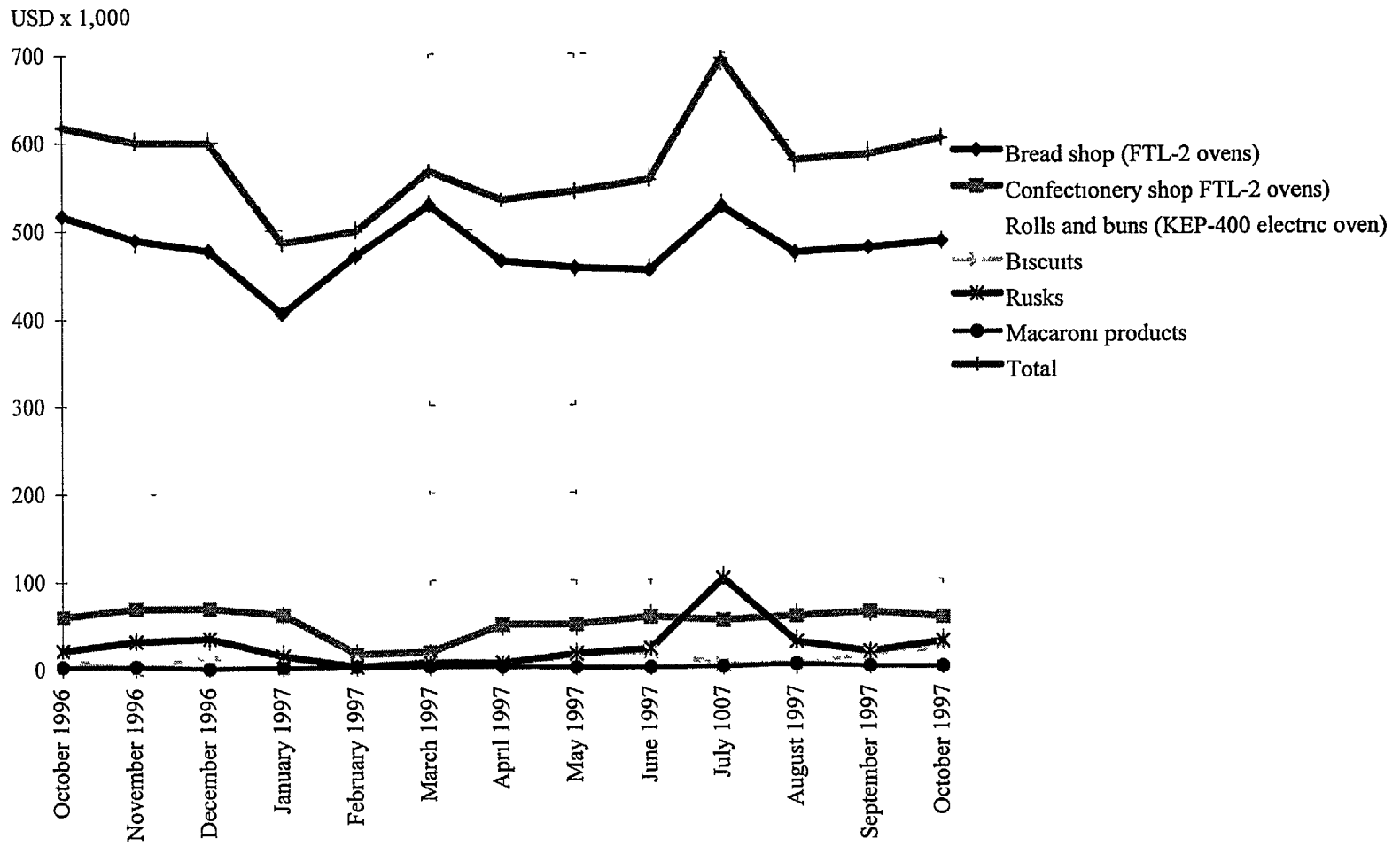


Fig 3 1 Monthly product output diagrams by product types

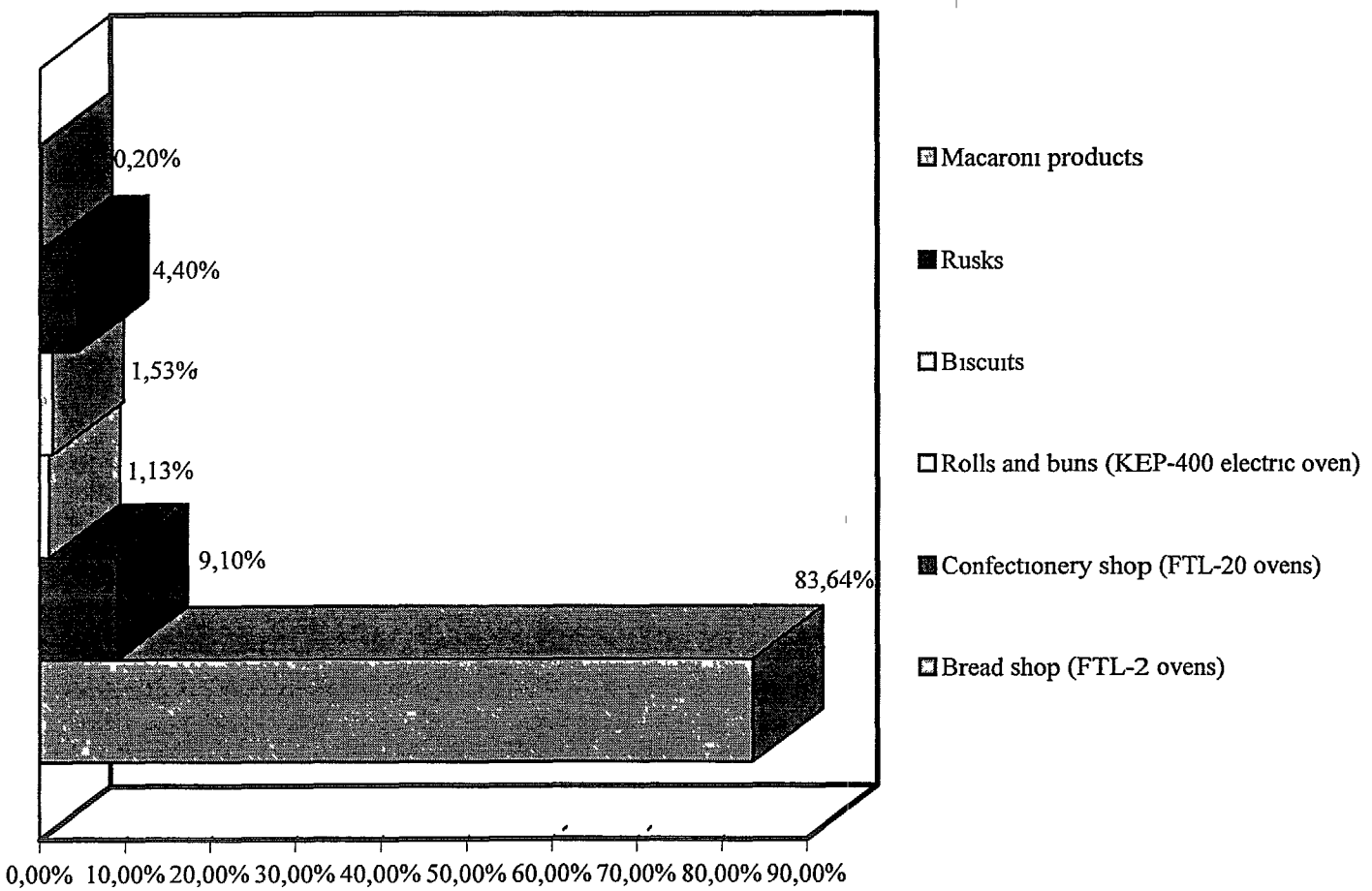


Fig 3 2 Average monthly product output value by product types

Table 3 2

Information on the product output of Lviv Bakery No 1 for 10 months of 1997 (January-October)

Shop (product type)	Mass of the commercial products	Commercial products value in current prices		Production prime cost in current prices		Profit in current prices		Profitability
	tonne	UAH/$	%	UAH/$	%	UAH/$	%	%
Bread shop (6 types of moulded and hearth baked bread) FTL 2 gas ovens	15 029 529	8,617,611 $4,658 168	82 2	7,334,072 $3,964 363	81 7	1,283,539 $693,805	85 3	17 5
Confectionary shop including	1 444 674	1,379,605 $745,732	13 2	1,233,392 $666,698	13 7	146,213 $79 034	9 7	11 85
FTL 20 gas ovens (rolls and buns)	1 268 957	1,046,306 $565 571	10 0	941,240 $508 778	10 5	105,066 $56,792	7 0	11 16
KEP 400 electric oven (rolls and buns)	92 613	92,613 7 $50 061	1 4	131,830 $71 259	1 4	17,327 $9 364	1 1	13 14
BEO biscuit machine	75 599		1 6	143,230 $774 221	1 6	22,778 $12 312	1 5	15 9
Macaroni products	7 504	18,134 $9 302	0 2	17,092 $9 239	0 2	1,042 $563	0 1	6 1
Rusk shop (rusks)	433 to 352	484,226 $261,744	4 6	408,423 $220,769	4 6	75,803 $40 980	5 0	18 56
Bakery total	**16,907 515**	**10,481,442 $5,665,644**	**100**	**8,975,887 $4,851,830**	**100**	**1,505,555 $813,813**	**10**	**16 77**

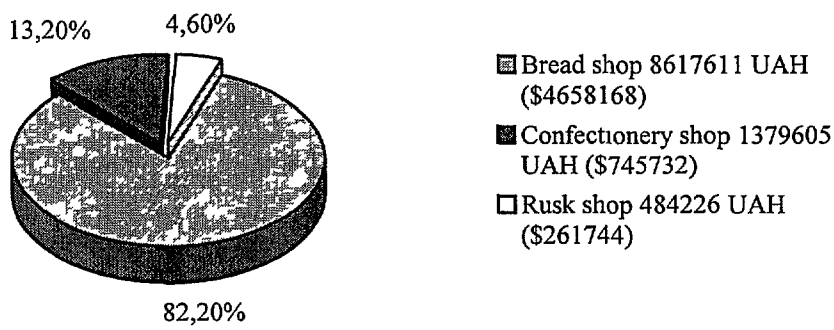


Fig 3 3 Commercial products value in current prices

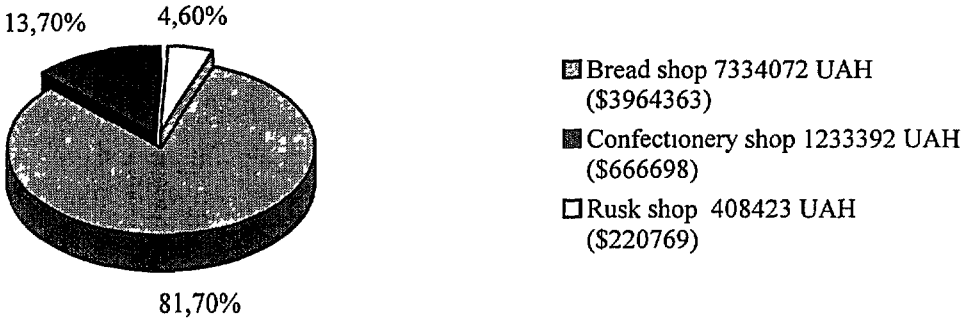


Fig 3 4 Production prime cost in current prices

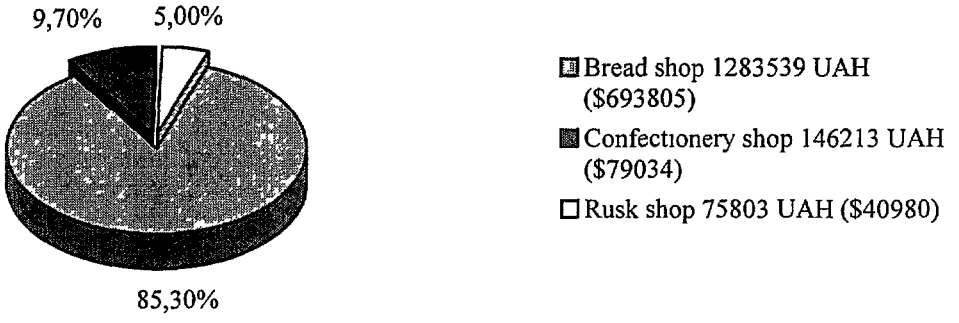


Fig 3 5 Profit in current prices

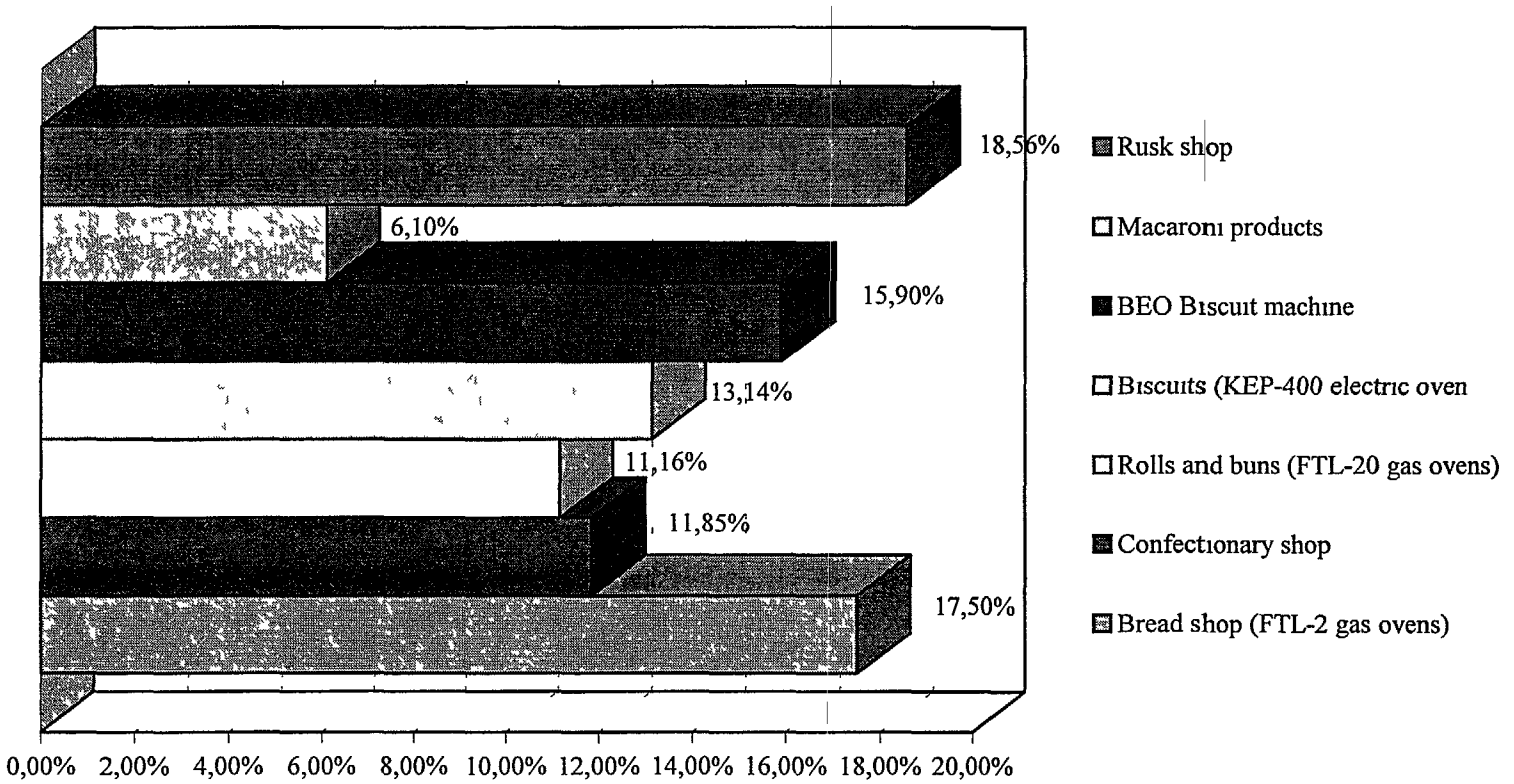


Fig 3 6 Bakery products profitability

4 ENERGY RESOURCE CONSUMPTION AND PURCHASE COSTS

4 1 Information on the energy resource consumption

Table 4 1 shows the data on gas, electricity, potable water and sewerage costs from October 1996 to October 1997 inclusive As can be seen from Table 4 1 the cost of energy resources does not exceed *6 49%*

Figures 4 1 and 4 2 show the dependence of changes in gas, electricity, potable water and sewerage costs from October 1996 to October 1997 inclusive in absolute ($) and relative (%) units respectively

The assessment shows (see Fig 4 3) that the gas costs are the most significant component of energy costs (*64 99%*) It has been unexpected that potable water costs (*17 1%*) exceed the electricity costs (*15 81%*) In the course of further analysis it turned out that earlier the enterprise used 4 wells to get water However, due to the pollution of this water with harmful components, its further utilisation proved to be impossible

4.2 Tariffs for gas, electricity and water

Lviv Bakery #1 purchases the energy resources, potable water and pays for sewerage according to the following rates

- electricity (one-rate tariff) $*42* per 1,000 kW h
- gas $*82* per 1,000 m^3
- potable water $*1,037 8* per 1,000 m^3
- sewerage $*292* per 1,000 m^3

Table 4 1

Gas, electricity and water costs for the period from October 1996 till October 1997

	October 1996	November 1996	December 1996	January 1997	February 1997	March 1997	April 1997	May 1997	June 1997	July 1997	August 1997	September 1997	October 1997	Total	Average monthly value	
Gas th m³/$	309 84 $25,407	305 65 $25,063	301 810 $24,748	300 0 $24,600	279 02 $22,880	270 0 $22140	260 0 $21320	248 606 $20386	289 684 $23,754	359 210 $29,465	300 0 $24,600	300 0 $2,4600	300 0 $24,600	3823 82 $313,553	29,414 $24,119	4 21%
Electricity, kWh/$	154,893 $6,506	168,100 $7,060	126,075 $5,295	154,890 $6,505	144,864 $6,084	146,688 $6161	136,882 $5749	121,272 $5093	135,483 $5690	122,675 $5,152	143,287 $6018	140,486 $5,900	120,072 $5043	1,815,677 $76258	139,667 $5866	1 02%
Potable water, m³/$	7,725 $8,017	7,305 $7,581	8,000 $8,303	6,461 $6,705	6,000 $6,227	4,050 $4,203	5,100 $5293	6,282 $6,520	6,377 $6618	6,730 $6,611	6,270 $6507	5,920 $6,144	6,130 $6362	82,350 $85,466	6,335 $6574	1 15%
Waste water, m³/$	2,313 $675	2,192 $640	2,400 $701	1,938 $566	1,800 $525	1,215 $355	1,530 $447	1,885 $550	1,913 $558	2,012 $587	1,881 $549	1,776 $518	1,839 $537	24,694 $7,208	1,900 $554	0 01%
Energy resources total, $/%	40,605 6 58%	40,344 6 73%	39,047 6 52%	38,376 7 91%	35,716 7 16%	32,859 5 8%	32,809 6 15%	32,549 5 98%	36,620 6 58%	41,805 6 02%	37,674 6 52%	37,162 6 37%	36,542 6 07%	482,485 6 48%	37,114 6 49%	6 49%
Products value, $	617,500	599,700	59,900	485,400	498,800	566,500	533,900	543,900	556,500	694,300	577,700	583,700	601,900	7,443,200	572,500	100%

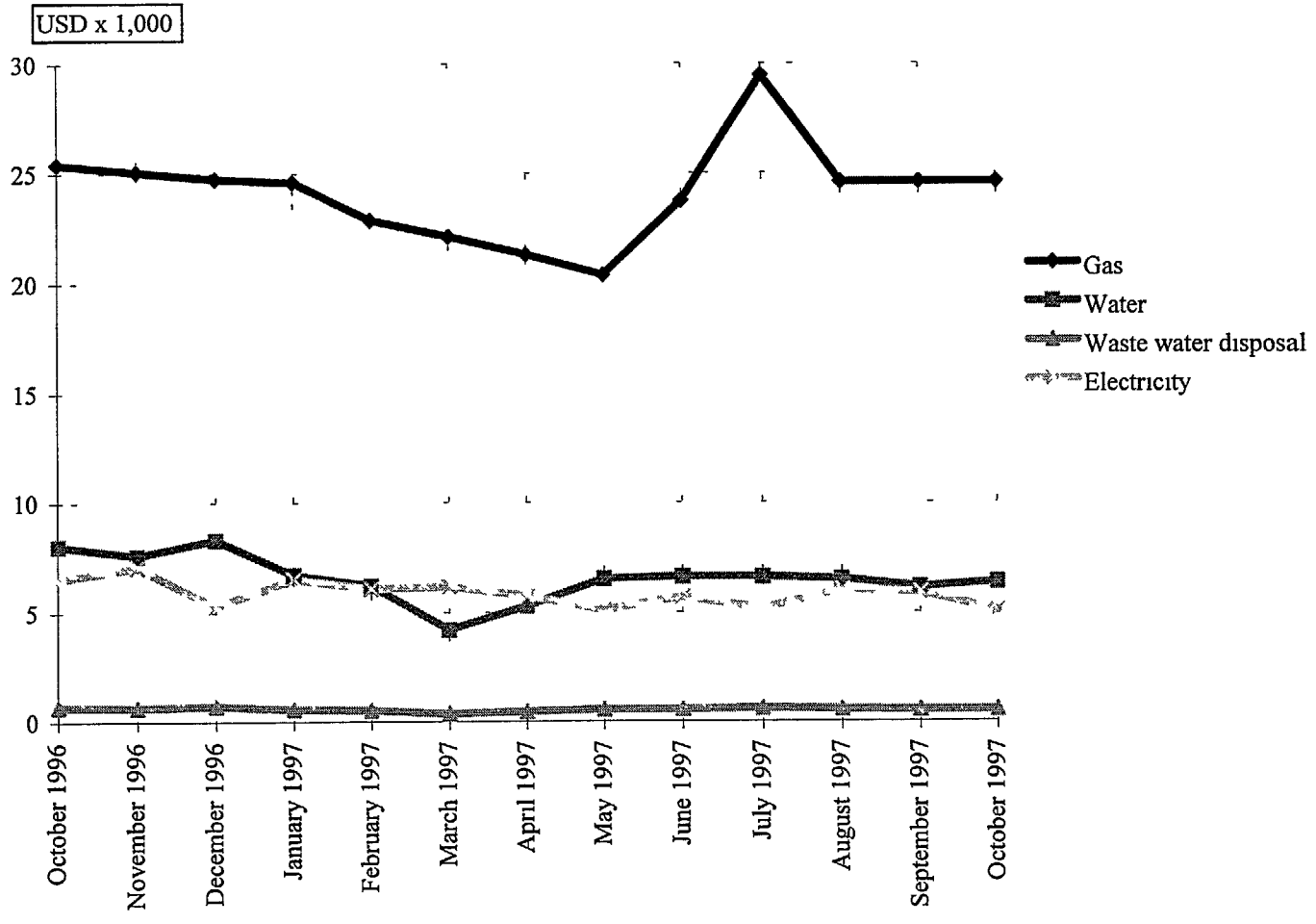


Fig 4 1 Dynamics of energy cost changes over the period from October 1996 till October 1997

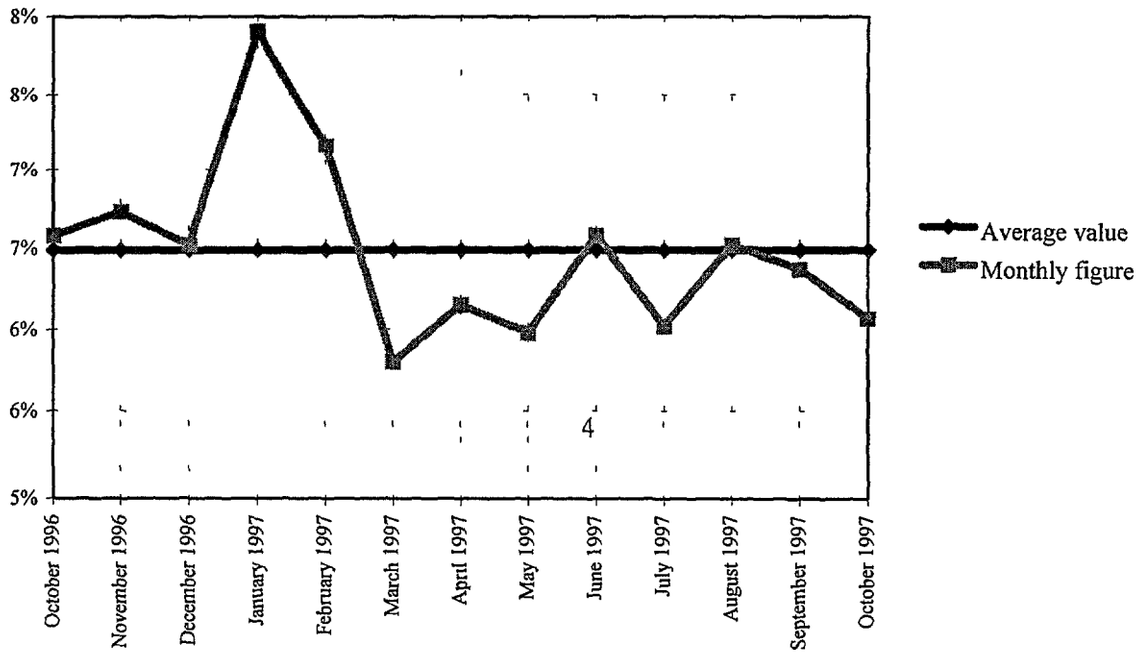


Fig 4 2 Dynamics of relative energy cost changes over the period from October 1996 till October 1997

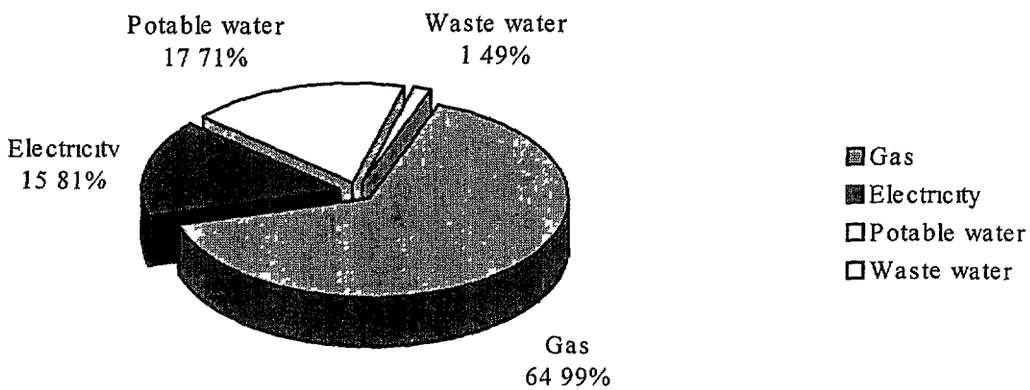


Fig 4 3 Energy cost structure

5 ENERGY RESOURCE CONSUMPTION BALANCE

5 1 Balance of electric power consumption

Balance of the electric power consumption by the main equipment is presented in Figure 5 1

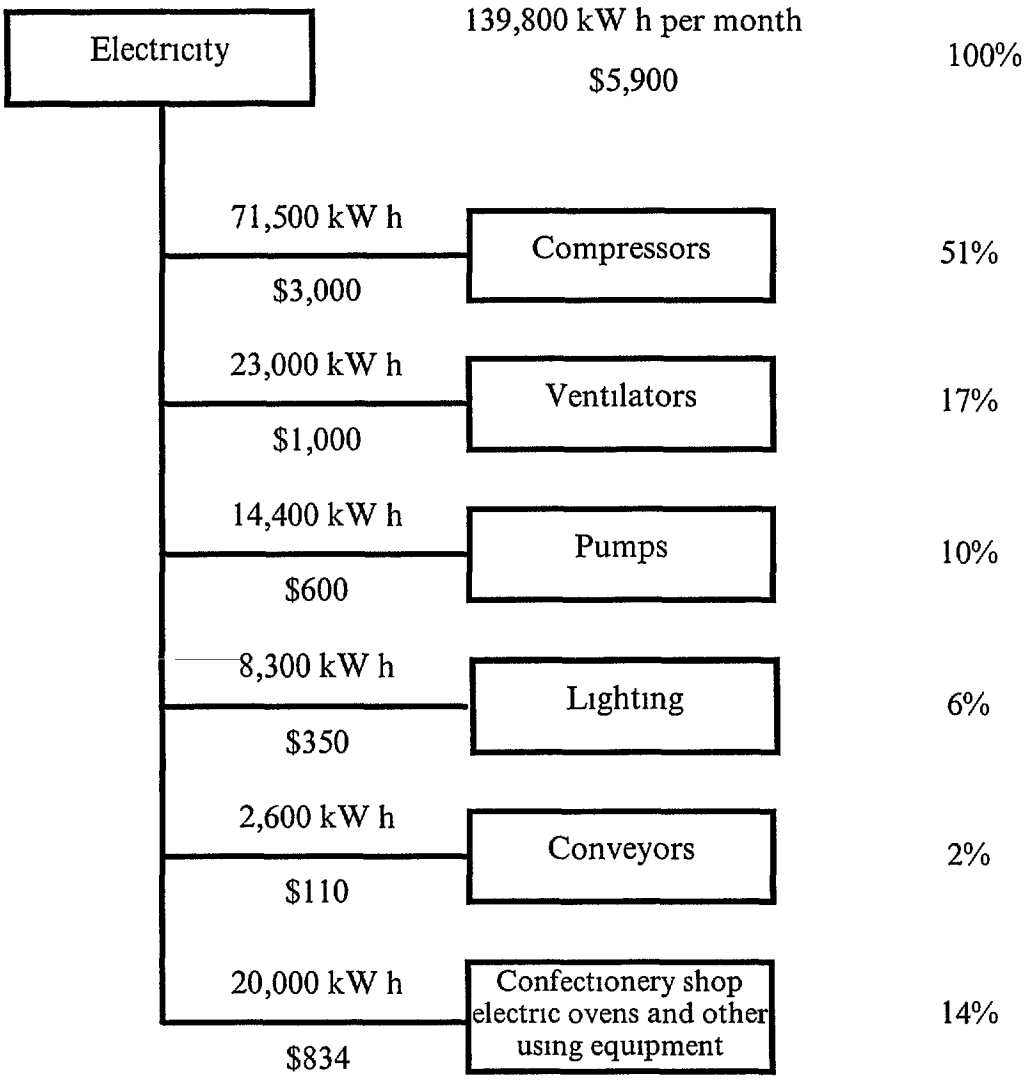


Fig 5 1 Monthly balance of the electric power consumption

5 2 Gas consumption balance

Balance of the gas consumption by the main equipment is presented in Figure 5 2

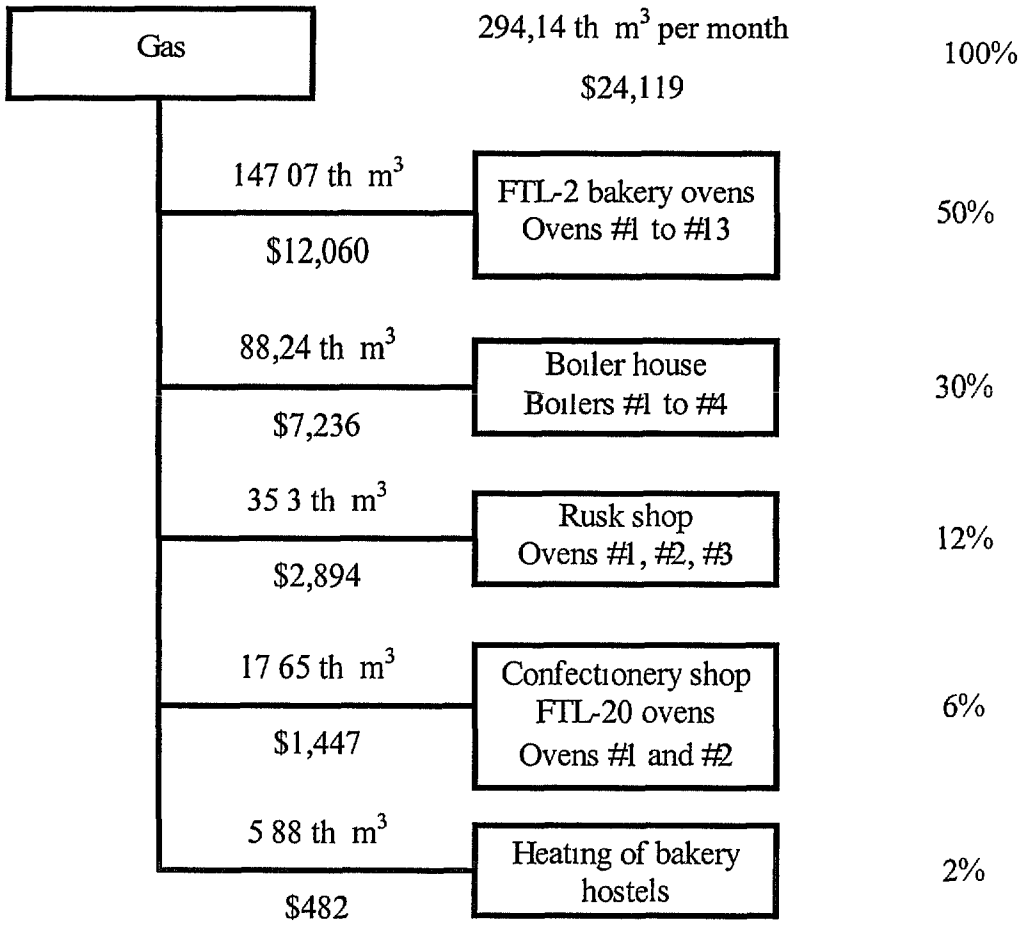


Fig 5 2 Average monthly balance of the gas consumption by main equipment

5 3 Water consumption balance

Balance of the water consumption by the main equipment is presented in Figure 5 3

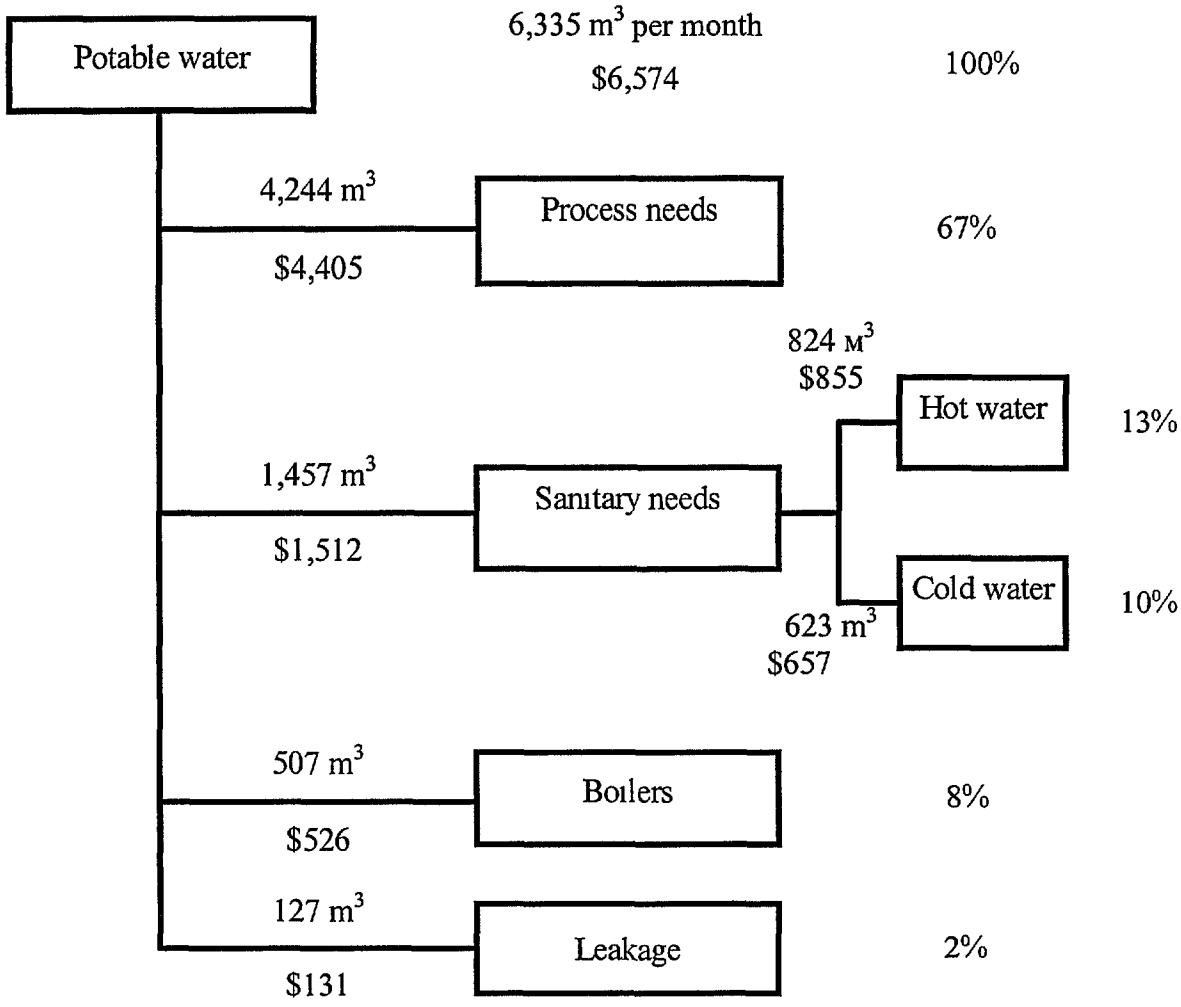


Fig 5 3 Average monthly balance of the potable water consumption

6 PREVIOUS STUDIES IN THE AREA OF ENERGY SAVING

In 1996 *RMK* Company (Kyiv) carried out a study of the energy consumption rates at this bakery At that time two compressor stations (old and new) were in operation The surveys made by RMK proved that due to different performance of the old and new compressor stations their simultaneous operation is inexpedient For this reason, the new compressor station has been decommissioned It is on stand-by for the case of the old station's failure

The study made by *RMK* proved that in average the average control range did not exceed ***25*** to ***50%*** of the nominal compressor capacity, which was testified by a great number of instrumental measurements performed by the company specialists of this company

7 ENERGY AUDIT

At *Lviv Bakery #1* the energy auditing group performed the works in the direct contact and with active participation of the following employees Mr Olexandr Ihnatenko, Chief Engineer, Mr Viktor Kuznetsov, Chief Mechanic Engineer, Mr Ihor Baida, Electric Engineer, Mr Vyacheslav Zarechny, Thermal Engineer

The below list of the energy saving opportunities was compiled jointly with the bakery employees

1 Study of a possibility to replace the currently existing ovens with new ones (more energy effective)
2 Increasing the level of loading the electric motors (replacing the underloaded electric motors with motors of lower power capacity
3 Installation of gas heaters in each building at the plant
4 Boring on the territory of the plant a well to have its own source of potable water
5 Installation on the radiators automatic valves for controlling temperature in rooms
6 Installation of an automatic system for controlling the level of steam supply into the gas ovens
7 Mounting measuring instruments for controlling the energy resources consumption
8 Replacement of energy consuming equipment with more efficient units
9 Improvement of the thermal insulation of the gas ovens
10 Implementation of a preliminary heating of the air supplied into the oven
11 Installation of heat exchangers to utilize the heat of the boiler exhaust gases
12 Analysis of reasonability of using three non-operated compressors
13 Decreasing the heat loss through the loading holes in the gas ovens
14 Decreasing the compressor speed rotation by using a belt drive or a speed rotation control of a compressor driving motor
15 Decreasing leaks of water, air and steam
16 Adjustment of the bread transportation speed in the oven
17 Improvement of the insulation of the hot water, steam and air supply pipe lines
18 Making sure of presence of the condenser batteries
19 Replacement of the old water chemical treatment system with an up-to-date one
20 Improvement of the heat insulation of the window
21 Study of reasonability of replacing the existing dough dosing apparatus with new ones, more precise
22 Utilization of the heat from the boilers and that of the gas from the ovens for dryings rusks
23 Replacement of the lighting fixture with more efficient units
24 Study of a possibility of re-adjustment of the burners, or of replacing them with more energy effective ones

The analysis resulted in selection of energy saving measures for their further studying, the measures are discussed on the following pages

7 1 Introduction of energy management

The proposal

Implementation at *Lviv Bakery #1* of an energy management system

The main instrument in reduction of energy consumption and improvement of the efficiency of energy utilization at industrial enterprises is energy management Energy management is a method of managing the enterprise providing continuous study and, consequently, knowledge of the distribution and conditions for energy consumption at the enterprise, as well as determining the optimal utilization of energy resources for both the production needs, and for the non-production needs

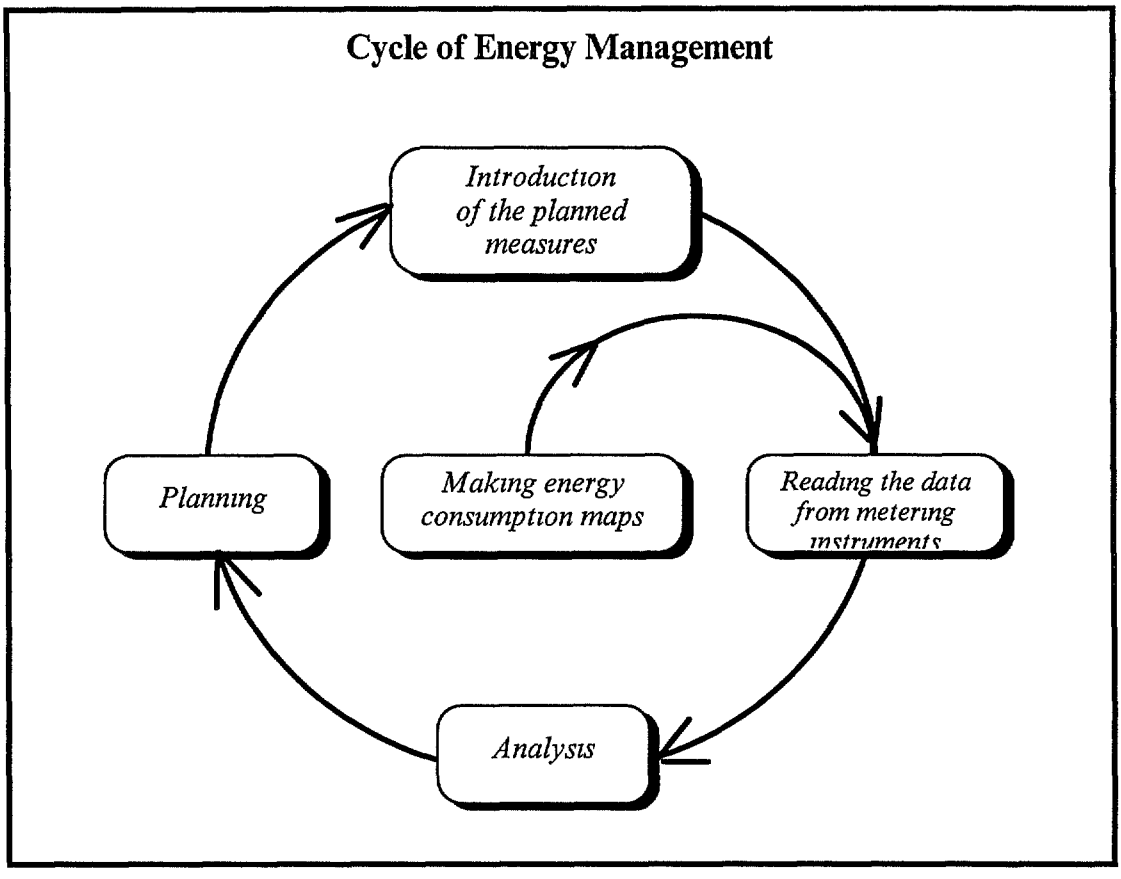


Fig 7 1

By implementation of energy management (see Fig 7 1) one can have a detailed picture concerning consumption of energy, which enables him to compare the energy consumption levels at other enterprises in order to determine exactly the energy saving projects that are planned for implementation at the given enterprise

Energy management starts with appointment by the top management of the plant of an executive to be responsible for introduction energy management at the enterprise – he is called the energy manager The main functions of the energy manager are as follows

- participation in making maps of energy consumption at the enterprise (probably in cooperation with an outside consultant - an energy auditor),
- collection of data concerning consumption of the fuel and energy resources using meters and measuring instruments and devices,

- making a plan of installing auxiliary meters and measuring instruments and equipment,
- collection of data concerning the flow of raw materials, fuel and energy and finished products,
- calculation of the key data in relation of improvement of the efficiency of energy utilization - on the whole and in regard of separate production lines or areas,
- introduction of new technologies for the existing and new energy systems to increase the energy efficiency of the production,
- the energy manager shall be aware of the current policy in the energy field (for example, the new legislation on taxation, the existing limitations in regard of the energy consumption levels, subsidies, issues relating to the environmental protection, etc)

We propose to introduce at the enterprise an energy management system in full scope Implementation of the given proposal is connected with a possibility of decreasing the energy consumption rate at least 3 per cent

Implementation of energy management at the plant requires performing a modernization of the existing system of metering the electric consumption rate with electric consumption meters

There is necessary to modernize the system of metering gas consumption at the gas controlling station with providing readings of the flow meters to a computer, with installation of auxiliary gas meters at each user's, which will enable to determine the dynamics of the gas consumption when producing products

It is necessary to acquire ***ENERAC 2000*** Combustion Analyzer to control the operation mode of *E-1,6-0,9* Boilers and *FTL-2, FTL-20* Gas Ovens, and if any need arises, to fulfil re-adjustment of the gas burners operation

Infra-red Thermomer "Heat Spy" of *DHS-26X* Model should be bought to keep under control the state of the thermal insualtion of the ovens, boilers and thermal lines? In order to identify its failures in due time

Calculation of yearly energy saving

Currently the plant consumes in average during a year ***1,661*** thousand kW h of electric power, ***3,514*** thousand m^3 of natural gas and ***74 6*** thousand of all-purpose water, the total sum of those is US $***442,000*** The world experience and practice prove that in case of implementation of energy management guarantees a 3 per cent decrease in energy consumption

So, the cost of the saved energy resources will be as follows
- for electric power
  1,661 thousand kW h ***x 0 03 = 50*** thousand kW h,
- for natural gas
  3,514 thousand m^3 ***x 0 03 = 105*** thousand m^3,
- for domestic water
  74 6 thousand m^3 ***x 0 03 = 2 2*** thousand m^3

Calculation of a yearly saving of costs

The yearly saving of energy costs, and, consequently, the permitted value of the cost of implementation of an energy management system, will be

US $***442,000 × 0 03*** = US $***13,260,***

where

$442,000 - the yearly cost of the energy resources,

0 3 - the minimum guaranteed decrease of consumption of energy resources resulting from implementation of energy management (***3%*** of the yearly energy costs)

Costs of implementation of the energy management service

The average payroll fund to implement the energy management tasks will be ***$250*** (taking into account the Chornobyl Fund, the Pension Fund, the Employment Fund, the income tax, etc)

As the said amount is approximately equal to the earnings of the Chief Thermal Engineer or Chief Energy Engineer, there can be recommended two following approaches

- to open a post of the Energy Manager directly at the enterprise (without approval of the Chief Mechanical Engineer) and subordinated to only the Chief Engineer,
- to divided the said amount between the specialists of the enterprise as additions to their salaries in the following way (depending on their personal participation in implementation of the energy conservation measures)

Chief Engineer	20%	20%	20%
Chief Mechanical Engineer	30%	30%	30%
Chief Energy Engineer	20%	15%	10%
Chief Thermal Engineer	30%	30%	35%

I must be noted that the said funds once may be used to reward the enterprise employees that contributed much into implementation of the energy conservation opportunities

The costs of the equipment (see the Specification of the required equipment in Appendix A) wsith taking into account the transportation and other are as follows

- *ENERAC 2000* - ***$5,000***
- *Heat Spy* **Intra-red Thermometer** - ***$1,000***
- modernization of the metering system - ***$4,000***

Total ***$5,000 + $1,000 + $4,000 = $10,000***

The total costs on implementation of an energy management service is

$250 12 + $10,000 = $ 13,000

Simple payback of the energy conservation measure

The simple payback for this energy conservation opportunity is

USD 13,000 / USD 13,260 = 0 98 year

Conclusions Adjustment and monitoring of the operation modes of the boilers and hot ovens, provision of controlling the state of the thermal insulation require buying ***ENERAC 2000*** Combustion Analyzer and ***Heat*** **Spy** infra-red thermometer, there is also required modernization of the energy consumption metering system

To implement a systematic approach to the energy management at the enterprise a post of an energy manager should be open at the enterprise with the yearly salary fund of ***$3,000***, or, without opening a separate post of an energy manager there should be put into practice material rewarding the bakery employees for implementation by them of the energy conservation opportunities

7 2 Energy conservation measures at the compressor stations

7 2 1 General information

The following proposals have been selected for further estimation in the process of discussion of possible energy saving measures

- study of electric motor load levels,
- study of the feasibility of the application of controlled electric drives for compressor actuation,
- investigation of the possibility of simultaneous utilization of the old (operational) and new (stand-by) compressor stations,
- study of the possibility to decrease the capacity of compressors due by using a mechanical gear with higher transmitting ratio in comparison with the existing one,
- installation of an automatic valve in order to maintain the constant pressure at the outlet of the compressor station

Let us consider these measures in more detail

In accordance with the draft state standard on energy saving one of the possible ways to save electricity in an electric drive is to increase the load level of underloaded motors So, (see Fig 7 2) if a motor operates in the load range of $0 \le k_L < (0\ 4$ to $0\ 45)$ in *S1* continuous mode, it is necessary to replace it with a motor of a lower capacity from the point of view of electric power saving If the motor operates in the range of $0\ 45 \le k_L < (0\ 6$ to $0\ 7)$, it is necessary to make calculations in order to evaluate the expediency of replacing the motor with one of a lower capacity (see the calculation approach in draft *DSTU*) It is not recommended to replace the motor under the $(0\ 6$ to $0\ 7) \le k_L \le 0\ 9$ motor load levels, as it operates with the optimum load

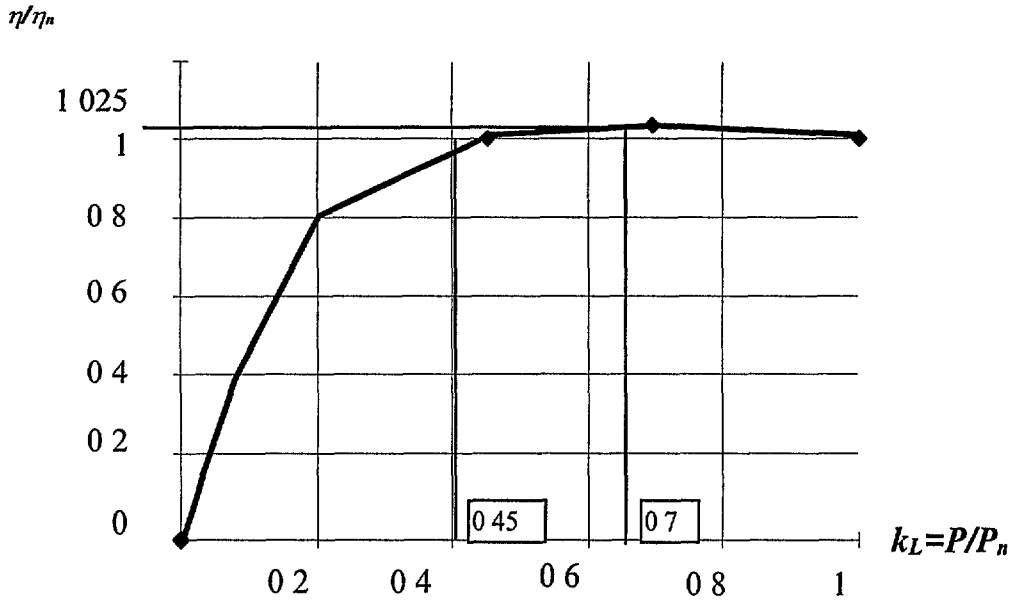


Fig 7 2 Curve of the efficiency of 10 - 100 kW asynchronous electric motors

η, η_n – actual and data-sheet motor efficiency,
P, P_n – actual and data-sheet electric motor capacity

7 2 2 Electric motor load level study

Contents of the proposal

To reduce the installed capacity of motors in order to reduce the power consumption

Study results

In accordance with the above, studies of the load levels of the following electric motors have been carried out

- *4A280M8* motors (capacity – 75 kW, nominal rotational speed – 720 rpm, nominal stator current – *143 A*) are installed at four compressors of the old compressor station,
- *4A250M8U3* power generators (capacity – 45 kW, nominal rotational speed – 740 rpm, nominal stator current – 73 4 A) are installed at the compressors of the new compressor station At present it is out of operation (stand-by),
- *4A160AS2* power generators (capacity – 15 kW nominal rotational speed – 2940 rpm, nominal stator current – 27 8 A) are installed at the cold water supply systems and at the circulating hot water supply system,
- *4A132M6R3T2* (capacity – 7 5 kW, nominal rotational speed – 960 rpm, nominal stator current – 16A) are installed in the rusk shop at the fans

A multimeter *FLUKE 85* Multimeter with a clamp-on power meter *FLUKE 80I-410* DC/AC Current Probe has been applied to measure the loads of the electric motors According to the measurement results, the motors under investigation had the following loads

Motor type (installation place)	***4A280M8* (old compressor)**	***4A160S2* (boiler house pump)**	***4A132M6P3T2* (fan in rusk shop)**
Actual current, A	112 5	17 5	7 5
Nominal current, A	143 0	27 8	16 0
Loading rate	0 787	0 63	0 47
Nominal capacity, kW	75 0	15 0	7 5

Conclusions Replacement of the investigated motors is not economically reasonable

Nevertheless, the investigation proved that fan pump motors can be replaced with motors of a smaller capacity during repairs or in case of their breakdown

- 15 0 kW motor – with 11 0 to 12 0 kW motor,
- 7 5 kW motor – with 4 5 to 5 kW motor

7 2 3 Study of the feasibility of the application of controlled electric drives for the compressor engines

Contents of the proposal

Control of the compressor station capacity by controlling the speed of compressors' actuating motors

Study results

There are two compressor stations at the enterprise - old and new ones

The old compressor station is equipped with four compressors of 202VP12/3CB type (stationary, one stage, double acting, with two simultaneously operating cylinders and circle cooling)

Technical data of the *202VP12/3CB* compressor are as follows

- injection pressure 3 5 kg/cm^2,
- capacity 12 m^3/min,
- power demand 50 kW,
- rotational speed per minute 735 r p m ,
- cooling water flow rate when its inlet temperature is 25 °C 20 l/min

  Drive a built-in *4A280M8* motor

- capacity 75 kW,
- nominal rotational speed 720 r p m ,
- voltage 380 V, three phases,
- nominal stator current 143 A

The new compressor station is equipped with three compressors of 4VU1-5/9 type (piston, V-typed, four row, four cylinders, two staged, directly acting)

Technical data of the 4BU1-5/9 compressor

- capacity according to the air intake conditions -5 ± 0 25 m^3/min,
- nominal rotational speed of the compressor shaft 740 r p m ,
- power demand in the data-sheet mode not more than 33 kW,
- power consumed by the compressor in the control mode not more than 22 kW,
- nominal outlet differential pressure 0,78 MPa (8 kg/cm^2),
- cooling by air,

Drive – a 3-phase asynchronous *4AM250 8UZ*-type motor with a squirrel-cage rotor

- capacity 37 kW (according to the data-sheet) but actually a 45 kW motor is installed,
- voltage 220/380 V,
- rotational speed 735 r p m ,
- frequency 50 Hz

The analysis of the power consumption by compressors showed that mostly one compressor operates most of the day The second compressor is switched on from time to time when a new lot of flour is delivered for unloading or the plant is working at full capacity The capacity of the compressor station is controlled manually by the attending personnel

In order to establish the feasibility of the controlled electric drive application for compressor actuation, the investigations have been carried out with the use of *DRANETZ SERIES_808* power analyser Table 7 2 and picture 7 3 show the curve of the daily load of Compressor #1 (from 16^{00} of November 18, 1997 till 16^{00} of November 19, 1997) The load curve is rather flat showing that the capacity is not controlled by the attending personnel According to the polling of the operating staff, the compressor station's capacity is carried out, in better case, when other compressors are turned on

The main purpose of control measures is to maintain the constant pressure in the system Besides, the average capacity control range will not exceed ***25*** to ***50%*** enabling to save not more than ***20*** to ***30%*** of the power consumed by compressors (see item 6)

Table 7 1

Daily loading of Compressor #1

No	Date	Time	Capacity, kW	Power factor
1	2	3	4	5
1	18 11 1997	16 00	62 70	0 85
2	18 11 1997	16 15	53 22	0 85
3	18 11 1997	16 30	60 27	0 85
4	18 11 1997	16 45	57 06	0 84
5	18 11 1997	17 00	55 08	0 83
6	18 11 1997	17 15	53 70	0 82
7	18 11 1997	17 30	53 73	0 82
8	18 11 1997	17 45	54 81	0 82
9	18 11 1997	18 00	59 88	0 83
10	18 11 1997	18 15	59 25	0 83
11	18 11 1997	18 30	51 54	0 80
12	18 11 1997	18 45	51 60	0 80
13	18 11 1997	19 00	54 24	0 81
14	18 11 1997	19 15	54 00	0 81
15	18 11 1997	19 30	52 77	0 81
16	18 11 1997	19 45	59 19	0 83
17	18 11 1997	20 00	56 55	0 82
18	18 11 1997	20 15	53 64	0 82
19	18 11 1997	20 30	54 81	0 82
20	18 11 1997	20 45	53 22	0 82
21	18 11 1997	21 00	52 08	0 81
22	18 11 1997	21 15	52 92	0 83
23	18 11 1997	21 30	55 20	0 83
24	18 11 1997	21 45	53 07	0 82
25	18 11 1997	22 00	49 92	0 80
26	18 11 1997	22 15	50 07	0 80
27	18 11 1997	22 30	49 35	0 79
28	18 11 1997	22 45	53 88	0 80
29	18 11 1997	23 00	57 18	0 81
30	18 11 1997	23 15	51 54	0 79
31	18 11 1997	23 30	53 70	0 81
32	18 11 1997	23 45	54 90	0 81
33	18 11 1997	24 00	56 70	0 81
34	19 11 1997	00 15	57 54	0 81
35	19 11 1997	00 30	59 43	0 82

No	Date	Time	Capacity, kW	Power factor
36	19 11 1997	00 45	57 21	0 82
37	19 11 1997	01 00	58 59	0 82
38	19 11 1997	01 15	57 06	0 81
39	19 11 1997	01 30	57 84	0 81
40	19 11 1997	01 45	58 23	0 82
41	19 11 1997	02 00	57 96	0 82
42	19 11 1997	02 15	58 92	0 82
43	19 11 1997	02 30	59 52	0 82
44	19 11 1997	02 45	57 96	0 82
45	19 11 1997	03 00	57 09	0 81
46	19 11 1997	03 15	57 24	0 81
47	19 11 1997	03 30	55 14	0 81
48	19 11 1997	03 45	58 86	0 82
49	19 11 1997	04 00	56 64	0 81
50	19 11 1997	04 15	52 83	0 79
51	19 11 1997	04 30	53 73	0 80
52	19 11 1997	04 45	58 08	0 82
53	19 11 1997	05 00	58 38	0 82
54	19 11 1997	05 15	57 63	0 82
55	19 11 1997	05 30	56 76	0 82
56	19 11 1997	05 45	59 01	0 82
57	19 11 1997	06 00	59 52	0 83
58	19 11 1997	06 15	60 39	0 83
59	19.11 1997	06 30	51 12	0 80
60	19 11 1997	06 45	57 27	0 83
61	19 11 1997	07 00	60 24	0 84
62	19 11 1997	07 15	59 76	0 84
63	19 11 1997	07 30	55 11	0 84
64	19 11 1997	07 45	55 71	0 84
65	19 11 1997	08 00	55 86	0 84
66	19 11 1997	08 15	56 76	0 84
67	19 11 1997	08 30	52 92	0 83
68	19 11 1997	08 45	54 48	0 84
69	19 11 1997	09 00	51 24	0 83
70	19 11 1997	09 15	53 13	0 83
71	19 11 1997	09 30	55 20	0 84
72	19 11 1997	09 45	57 06	0 85
73	19 11 1997	10 00	55 41	0 85
74	19 11 1997	10 15	55 83	0 84
75	19 11 1997	10 30	55 32	0 85
76	19 11 1997	10 45	48 12	0 82
77	19 11 1997	11 00	46 56	0 81

No	Date	Time	Capacity, kW	Power factor
78	19 11 1997	11 15	46 71	0 81
79	19 11 1997	11 30	50 61	0 83
80	19 11 1997	11 45	54 45	0 84
81	19 11 1997	12 00	58 59	0 85
82	19 11 1997	12 15	58 11	0 84
83	19 11 1997	12 30	55 89	0 84
84	19 11 1997	12 45	60 90	0 85
85	19 11 1997	13 00	59 01	0 85
86	19 11 1997	13 15	57 81	0 85
87	19 11 1997	13 30	55 95	0 84
88	19 11 1997	13 45	57 27	0 85
89	19 11 1997	14 00	55 15	0 84
90	19 11 1997	14 15	56 14	0 84
91	19 11 1997	14 30	53 34	0 84
92	19 11 1997	14 45	54 48	0 84
93	19 11 1997	15 00	55 41	0 84
94	19 11 1997	15 15	54 60	0 84
95	19 11 1997	15 30	54 36	0 84
96	19 11 1997	15 45	53 22	0 83
97	19 11 1997	16 00	55 15	0 84

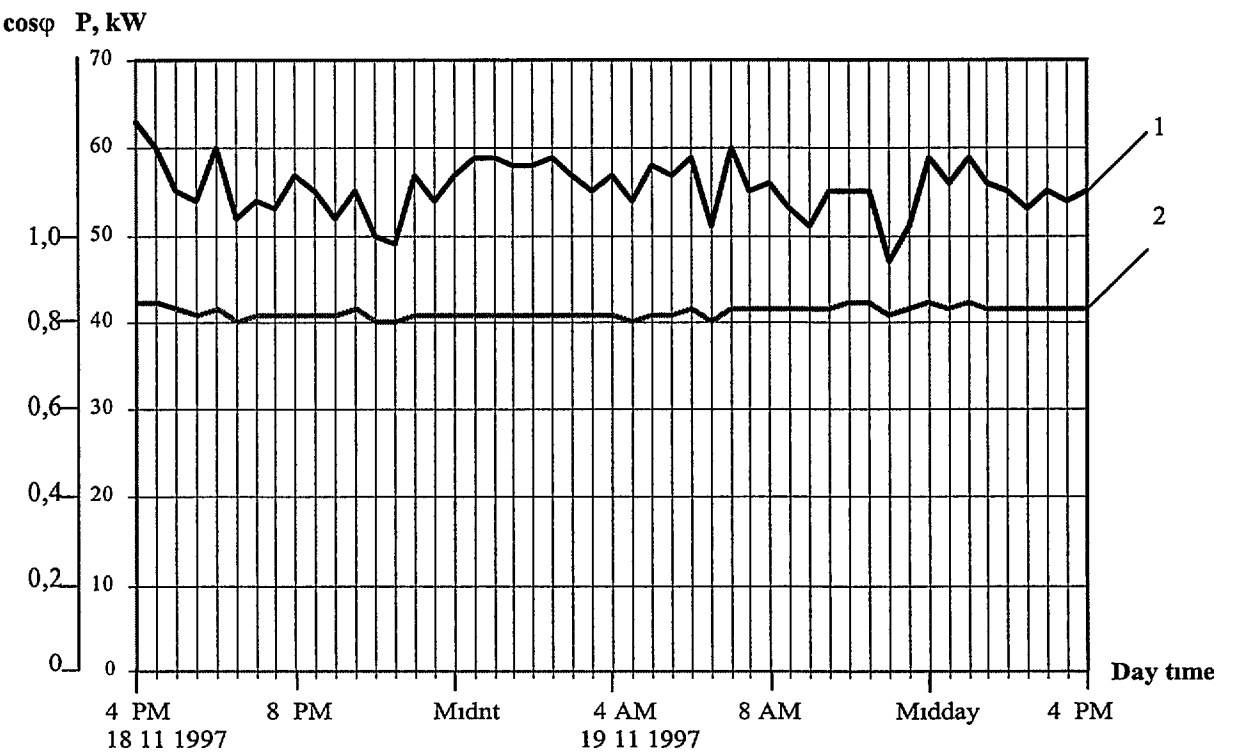


Fig 7 3 Compressor #1 daily load curve

1 – power consumed by the motor of Compressor #1, 2 – power factor

Thus, the expected annual savings due to electric drive control system introduction at the old compressor station will be 20 per cent of the electric power consumed by the compressors

$$(0\ 2\ \ 71{,}500\ kW\ h/month\ = 171{,}600\ kW\ h\ per\ year$$

or

$$0\ 2\ \ \$3{,}000\ \text{per month}\ \ 12\ month/year = \$7{,}200,$$

where *71,150* kW h/month – a monthly consumption of electric power by compressors,

$*3,000* per month - an average monthly cost of the electric power consumed by the compressors,

12 months – the number of months in the year

The cost of a frequency converter (see Appendix A) to control the rotational speed of the motor of one of the compressors will be as follows

- $*6,250* for domestic converters,
- $*10,000* for imported converters,

The cost of frequency converters for four compressors will be as follows

- $*25,000* for converters manufactured in Ukraine,
- $*40,000* for converters manufactured in the USA

The cost of additional equipment and adjustment of the whole control system will be $*5,000*

Total costs of the implementation of energy saving measures will be as follows

- $*25,000* + $*5,000* = $*30,000* – for converters manufactured in Ukraine,
- $*40,000* + $*5,000* = $*45,000* – for converters manufactured the USA

Simple payback period

- For the converters manufactured in Ukraine (the cost is $*30,000*, the annual saving – $*7,200*)

  $30,000 / $7,200 = *4,17* years,

- For the converters manufactured in the USA (the cost is ***$45,000***, the annual saving – $*7,200*)

  $45,000 / $7,200 = 6 25 years

Conclusions The simple payback of this measure is above 2 years, so the precise calculations should be done with taking into account discounting

Application of frequency converters manufactured in the USA is not economically feasible, because the lifetime of a converter can be less than the simple payback period

Irrespective of the lower quality (reliability) of the converters manufactured in Ukraine they, nevertheless, can be referred to the long-term energy saving measures as not more than two compressors should operate simultaneously Thus, even if only one adjusting person is available at the enterprise, the reliable generation of compressed air will be ensured

7 2 4 Investigation of the possibility of simultaneous utilization of the old (operational) and new (stand-by) compressor stations

Contents of the proposal

Compressors of both old and new compressor station are of the different capacity and productivity The new compressor station is equipped with the system maintaining the constant outlet pressure in the air duct

Proper selection of the number of simultaneously operating compressors of old and new compressor stations will enable to decrease the capacity stage discreteness of two compressor stations and, hence, to reduce the losses associated with the control of their total capacity

Study results

According to the calculations, the reduction in capacity stage discreteness of two compressor stations enables to decrease power losses related to the compressed air generation by *4* to *5*%, i e by $*1,441* to $*1,802* per year Technical data of the compressors of the old and new compressor stations are provided above (see Item 7 2 3) The analysis shows that compressors have different technical characteristics in terms of the air pressure and capacity According to the results of preceding energy audit carried out in 1996, the total capacity of the compressors of the old and new compressor stations (see Section 6) during their simultaneous operation did not correspond to the designed one This proves that compressors delivering high pressure prevent the compressors with lower pressure from normal operation Thus, the new compressor station was decommissioned after the preceding audit Controlled drive systems could be an alternative to such a decision However, bearing in mind that savings are less by *4* to *5* times in comparison with the measure described in Item 7 2 3, such an approach becomes not expedient

Conclusions Because of the difference in compressor characteristics of the old and new compressor stations, their simultaneous application is not economically expedient

7 2 5 Introduction of a system maintaining the constant outlet pressure of the old compressor station

Contents of the proposal

Introduction of a system maintaining the constant outlet pressure of the old compressor station by way of pressure sensor and control valves installation

Study results

In order to implement the system maintaining the constant outlet pressure of the old compressor station, the following equipment is required

- pressure sensor 1 unit,
- control valve 1 unit,

- controller 1 unit,
- pilot relay 4 units,
- block valves 4 units,

The total cost of required equipment taking into account customs and transportation costs is $\$1,950$ Taking into account the average value of the power consumed by compressors during the day (*99 3* kW), the average savings value will be at least *6*%, which will amount to ***50,000 kW h*** that costs $\$2,100$ per year
Thus, the payback period of this energy saving measure is

$$\$1,950/\$2,100 = 0\ 93 \text{ year}$$

Conclusions Taking into account the short payback period (*0 93* year) and comparatively low implementation costs ($\$1,950$) of this energy saving measure, it can be considered as one of the most promising measures

7.3 Energy saving measures in the FTL-2 bakery ovens

7 3 1 General information

In the course of discussion of possible energy saving measures the following proposals have been selected for further evaluation

A improvement of thermal insulation of the bakery ovens,

B control of steam supply to the oven

FTL-2 swinging tray/hearth oven is intended for baking a wide range of products A blind-end baking oven chamber contains a swinging tray/hearth double-strand baking conveyer 24 swinging trays of 1,920 mm length and 350 mm width are suspended at every third link of the two 140 mm pitch chains

The intermittent motion of the oven conveyer is achieved by halt of the driving electric motor with a cam plate (dog) mounted at the worm wheel shaft serving as reducer After one revolution the cam plate presses the limit switch spindle causing the electric motor and conveyer to stop The electric motor is switched on with a time relay adjusted to a pause as required to bake each product

Heating of the oven is ensured in the following way flue gas from the oven is going through the lower gas flue and a vertical standpipe to a radiator tank, further the gas rises through the standpipes into two wide ducts of the upper flue Afterwards, the gas going through the ducts washes three small water heating boilers and escapes through the duct into the funnel

The environment of the baking chamber is humidified with steam coming from the boiler house

The process of baking should be organised in accordance with the continuous method which envisages that every swinging tray is freed from finished products after certain period and at once loaded with dough feed Continuous method of baking allows to create proper steam conditions and stable temperature, improves the quality of baked goods and increases the capacity of the oven

The main parameters of baking processes - duration of the hearth revolution, temperature in the baking chamber, humidity of the steam and air environment - must correspond to the sort of baked goods

Duration of the hearth revolution or baking time is controlled with a timer

At present, the temperature condition is not controlled due to the lack of thermometers The steam condition of the baking chamber is controlled by changing the rate of the steam supply from the boiler house

7 3 2 Improvement of thermal insulation of the FTL-2 bakery ovens

Contents of the proposal

To reduce heat losses from the walls of *FTL-2* ovens by means of improvement of their thermal insulation

Study results

In order to establish the feasibility of the improvement of thermal insulation of the walls of *FTL-2* ovens, temperature of the walls was measured For this purpose a ***DHS-26X "Heat Spy" infrared thermometer*** was used The measurements showed that the average temperature of oven surface was ***66*** °C although the efficient temperature is ***22*** °C In certain places of the outside surface of the ovens the temperature reached ***90*** to ***95*** °C evidencing that their thermal insulation was damaged The FTL-2 bakery ovens have been in operation since ***30*** years, and they are subject to refurbishment The bakery management plans to refurbish them but it will be done not earlier than in ***3*** to ***5*** years Natural gas will be saved after taking this measure

Improvement of the oven thermal insulation allows to save

$$Q = a \ \Delta T \ S, \text{ (kcal/h)},$$

where $a = 1\ 5$ kcal/(m^2 °C) – is a constant,

$\Delta T = (66 - 25)$ °C – difference between the oven temperatures before and after installation of thermal insulation,

$S = 70\ 76$ m^2 – oven surface area

Then

$$Q = 1\ 5 \ (66 - 25) \ 70\ 76 = 4{,}352 \text{ kcal/h}$$

The annual savings will be as follows

$$4{,}352 \text{ kcal/h} \ 8{,}760 \text{ h/year} = 38{,}000{,}000 \text{ kcal/year} = 38 \text{ Gcal/yr}$$

Which is equivalent to the following saving of natural gas ($Q^{oper}_{Low} = 8{,}100$ kcal), if the combustion efficiency is ***85%***

$$38{,}000{,}000 / (8{,}200 \ 0\ 85) = 5{,}500 \text{ m}^3\text{/yr}$$

If 1,000 m^3 of natural gas cost ***$82***, the annual savings from installation of additional thermal insulation will be the following

$$5\ 5 \ 82 = \$450 \text{ per year}$$

The cost of 1 m^2 of thermal insulation is $4

Material – thermoinsulating basalt matresses *TM-10* (*RSTU-1981-87*, meas -1)

The cost of insulation for 1 oven is as follows

$$70\ 76 \text{ m}^2 \ \$4 = \$283$$

(For more details see Appendix A)

The payback period is as follows

$$\$283 / \$450 \approx 0\ 63 \text{ year}$$

Conclusions Taking into account the fact that the costs of additional thermal insulation of the ovens will be recovered in *0 63* year, this measure can be recommended for the implementation at all *13* ovens as a measure with a short-term medium payback period However, with that one has to take into consideration how long the *FTL-2* ovens are to be operated? As the bakery management is planning to replace these ovens with new ones, more economical and productive

7.3.3 Control of steam supply to FTL-2 bakery oven

Contents of the proposal

Currently, various bread sorts made of flour and dough of different quality, and with varying amount of water are baked in *FTL-2* ovens This requires that the amount of the steam supplied to the oven to maintain the required air humidity in two moistening zones be permanently regulated

Study results

The amount of the steam supplied into the oven, is controlled with valves operated by the Chief Thermal Engineer The control is performed manually to produce bread of good quality (on the basis of a visual estimation) and on the basis of the personal experience, this sets the valve state

The estimated stream required is *170* kg per oven per hour Currently, this leads to almost twice as much steam, as it is required (*300* kg of steam per hour)

The equipment required to implement this measure is shown in Fig 7 4

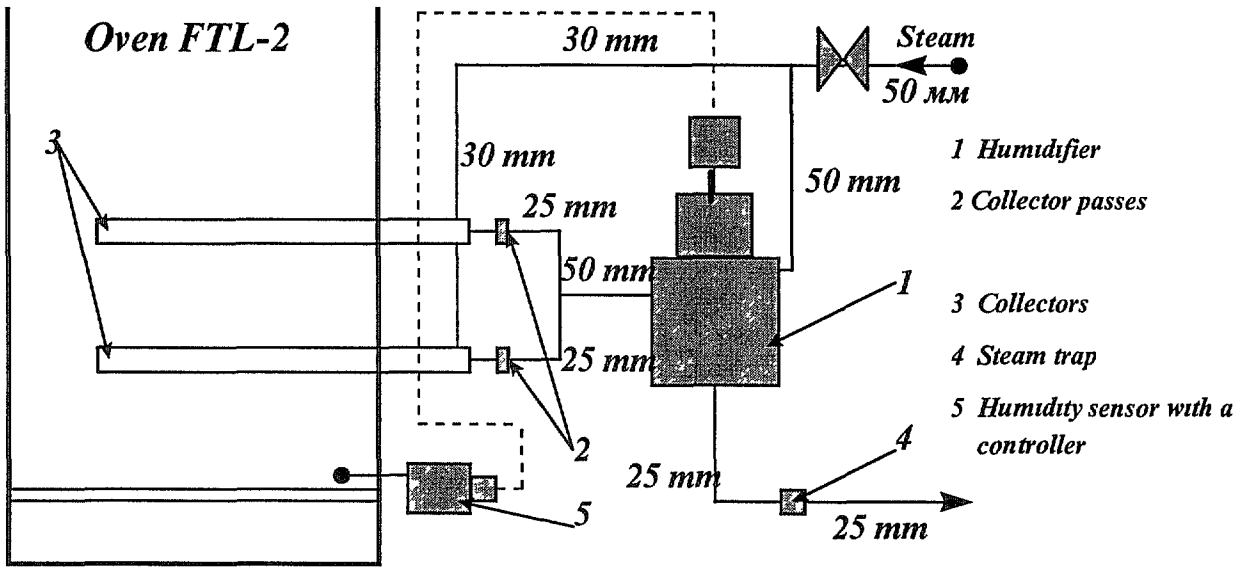


Figure 7 4

The cost of this measure implementation is ***$5,000*** (see Appendix A)

The oven operates *24* hours per day, i e *8,760* hours per year The annual steam saving will amount to

(*300 - 170*) kg/hour *8,760* hours = ***1,138,800*** kg,

or, in heat terms

1,138,800 kg/yr *650* kcal/kg = ***740,220,000*** kcal/yr = ***740 22*** Gcal/yr

If ***1,000*** m^3 of natural gas cost ***$82***, the savings on production of steam for one *FTL-2* oven will be as follows

$82 106 = $8,700

The payback period of this measure will be

$5,000 / *$8,700= 0 57* year

Conclusions This measure is the most promising one for the implementation at Lviv Bakery #1 It can be recommended for all 13 ovens in the bread baking workshop In this case it is necessary to buy equipment the total cost of which is **$65,000**

7 4 Improvement of the operation efficiency of *E 1,6-0,9* boilers in Lviv Bakery #1 boiler-house

7 4 1 General information

At present, the boiler house of Lviv Bakery #1 has four operational *E-1,6-0,9* boilers operated on natural gas

The boilers were commissioned in 1992 and are kept in good condition Natural gas is burnt and the boiler produce steam (1 6 t per hour) at 1 2 Bar

The boilers generate steam for the following purposes

- to humidify the operating chambers of *FTL-2* ovens to bake bread — 51%
- to humidify the operating chambers of *FTL-20* ovens to bake rolls and buns — 9%
- to pre-heat the hot water for space heating during the winter period — 34%
- to pre-heat the hot water for process needs — 6%

Total *100%*

The boilers consume about *147 07* thousand m^3 of gas per month or *30%* of bakery's demand

The following measures have been selected from the general list of potential energy saving recommendations

- Improvement of the thermal insulation of the boilers,
- Utilization of the flue gas heat for pre-heating of the hot water for process needs and space heating during the winter period

7 4 2 Improvement of the thermal insulation of the boilers

Contents of the proposal

Improvement of the thermal insulation of boilers in order to reduce the heat losses

Study results

To investigate the feasibility of improving *E-1,6-0,9* boiler walls, the wall temperatures were measured ***The DHS-26X "Heat Spy"*** infrared thermometer was used for the measurements The measurements of the temperature of outside surfaces of the boilers proved that Boiler #2 had the local (~*0 1* m × *0 1* m) temperature increase up to *126* °C The energy auditors drew the attention of local operators to this fact As a result, the bakery management made a decision to compulsorily repair the destroyed boiler's fire-proof covering after its outage The measurements also proved that the average temperature of boiler surfaces is *40* to *50* °C The mentioned values correspond to the current regulations and standards of Ukraine Nevertheless, the calculations were made (see below) for thermal insulation used to reduce the temperature of outside surfaces of the boilers down to

35 °C

By improving the thermal insulation of the boilers there will be saved (the calculation approach see in Item 7 3 2)

$$1{,}5 \quad (50 - 35)\ ^\circ\mathrm{C} \quad 4 \times (2\ 5 \times 2\ 5) = 562\ 5\ \mathrm{kcal/h}$$

The annual saving will be as follows

$$562\ 5\ \mathrm{kcal/h} \quad 8{,}760\ \mathrm{h/yr} = 5{,}000{,}000\ \mathrm{kcal/yr}$$

The approximate amount of natural gas consumed to produce *1* Gcal of heat (at $\eta = 85\%$, $Q^{oper}_{Low} = 8{,}100$ kcal/m^3) is *145* m^3/Gcal So, the gas savings are as follows

$$5\ \mathrm{Gcal/yr} \quad 143\ \mathrm{m^3/Gcal} = 725\ \mathrm{m^3/yr}$$

It will result in the cost savings (if *1,000* m^3 of natural gas cost *$82*)

$$\$82 \quad 0\ 725 = \$60$$

The cost of the insulation for one boiler is

$$(\$4/\mathrm{m^2}) \quad 4 \times (2\ 5\ \mathrm{m} \times 2\ 5\ \mathrm{m}) = \$100$$

The payback period is

$$\$100 / \$60 = 1\ 67\ \mathrm{yr}$$

As at the same time not more than two boilers out of four are working, in case of providing any additional insulation for all four boilers, the payback period for such an energy saving measure will be as follows

$$(\$100 \quad 4)/(\$60 \quad 2) = 3\ 33\ \mathrm{yr},$$

and the gas savings will be

$$725\ \mathrm{m^3/yr} \quad 2 = 1{,}450\ \mathrm{m^3/yr}$$

Conclusions As simultaneously there work not more than 2 boilers out of the four, it does not seem reasonable to provide additional thermal insulation at all the boilers It seems

worth to provide thermal insulation on a stage-by-stage basis first on the two main boilers, and then on the two redundant ones

It is necessary to provide a local repair of the fire-proof covering on Boiler #2

7 4 3 Utilisation of the heat of the combustion products leaving E-1,6-1,9 *Boiler*

Contents of the proposal

A heat exchanger should be installed to recover and then utilize the heat of the combustion gasses to provide hot water for the processing needs and to heat premises in the winter time

Study results

According to the results of tests carried out with application of an ***ENERAC-2000*** gas analyser (see Appendix B), the amount of heat carried away from the boiler by the combustion products prior to the installation (Q_1) and after the installation (Q_2) of a heat exchanger can be determined for the combustion product temperatures $t_1 = 152$ °C and $t_2 = 107$ °C respectively

$$Q_1 = G \quad i_1,$$

$$Q_2 = G \quad i_2,$$

where $G = 150$ m^3 – per hour is boiler's natural gas consumption (the low heat value is Q^{oper}_{Low} = = *8,100* kcal per m^3, the volume of combustion products is *11 85* m^3 per *1* m^3 of gas for the air consumption coefficient of 1 23),

$i_1 = 600$ kcal/m^3, $i_2 = 350$ kcal/m^3 – is the heat content of combustion products per *1* m^3 of the gas consumed by the boiler at the temperatures of t_1 = *152* °C and t_2 = *107* °C respectively

Possible heat saving due to the exhaust gas cooling from *152* °C to *107* °C amounts to

$$Q_E = Q_1 - Q_2 = G \quad i_1 - G \quad i_2 = G \quad (i_1 - i_2) = 150 \quad (600 - 350) = 37{,}500 \text{ kcal per hour}$$

Taking into account the heat exchanger efficiency of *80%*, the following amount of gas will be saved

$$G_E = 0\ 8 \quad Q_E / Q^{oper}_{Low} = 0\ 8 \quad 37{,}500/8{,}100 = 3\ 7 \text{ m}^3 \text{ per hour}$$

The annual saving will amount to

$$(3\ 7 \text{ m}^3/\text{hour}) \quad (8{,}760 \text{ hours/year}) = 32{,}400 \text{ m}^3 \text{ per year}$$

The cost of the gas saved during one year will amount to

$$(32{,}400 \text{ m}^3 \text{ per year}) \quad 0\ 082 \text{ \$/m}^3 = \$2{,}660$$

The value of the required equipment including the transport and other expenses will amount to \$*5,100* (for details see Appendix A)

The payback period of this measure will be

$$\$5{,}100 \ / \ \$2{,}660 = 1\ 92 \text{ year}$$

As at the same time not more than two boilers out of four are working, in case of providing any additional insulation for all four boilers, the payback period for such an energy saving measure will be as follows

$$(\$15{,}100 \quad 4)/(\$2{,}660 \quad 2) = 3\ 84 \text{ yr},$$

and the gas savings will be

$$732{,}400 \text{ m}^3/\text{yr} \quad 2 = 64{,}800 \text{ m}^3/\text{yr}$$

Conclusions As simultaneously there work not more than 2 boilers out of the four, it does not seem reasonable to provide additional thermal insulation at all the boilers It seems worth to provide thermal insulation on a stage-by-stage basis first on the two main boilers, and then on the two redundant ones

8 ENVIRONMENTAL IMPACT OF THE RECOMMENDED MEASURES

Implementation of the energy saving measures will result in the reduction of harmful emissions into atmosphere owing to reduced fuel and electricity consumption According to the average data from the enterprise for boilers and small ovens, burning of ***1,000*** m^3 of gas results into the following emissions into the atmosphere

CO – (carbon monoxide) – 0 28 kg,

NO_x – (nitrogen oxides) – 1,458 kg,

In 1996, the average harmful emissions per ***1,000*** kWh of produced electricity, within the system of the Ministry of Energy of Ukraine, was as follows

CO – 0 51 kg,

NO_x – 2 177 kg,

SO_2 – 9 89 kg,

Ash – 4 365 kg

Implementation of the proposed energy saving measures will allow to reduce the natural gas consumption by ***1,620 75*** m^3 and electricity consumption by ***271,600*** kWh, which is equivalent to the following reduction of harmful emissions into the atmosphere

CO (***1,620,750*** m^3) (***0 28*** kg/thousand m^3) + (***271,600*** kWh) ×
× (***0 51*** kg/thousand kW h) = ***592*** kg

NO_x (***1,620,750*** m^3) (***1 458*** kg/thousand m^3) + (***271,600*** kWh) ×
× (***2 177*** kg/ thousand kW h) = ***2,954*** kg

SO_2 ***271,600*** kW h ***9 89*** kg/thousand kW h = ***2,686*** kg

Ash (***223,100*** ***308,900***) kW h) (***4 365*** kg/thousand kW h) =***1,186*** kg

APPENDIX A LIST OF POSSIBLE ENERGY SAVING MEASURES

List of possible energy conservation measures (ECOs)

#	Description	Electric power saving, kW h	Natural gas saving, m³	Yearly saving, USD	Measure costs, USD	Payback period, yr	Item in this report
1	Introduction of energy management service	50,000	105,000	$13,260	$13,000	0 98	7 1
2	Controlling supply of steam into *FTL-2* Baking Oven - for one oven - for **13** ovens	 0 0	 106,000 1,378,000	 $8,700 $113,100	 $5,000 $65,000	 0 57 0 57	 7 3 3 7 3 3
3	Improvement of thermal insulation of *FTL-2* Bread Ovens - for one oven - for **13** ovens	 0 0	 5,500 71,500	 $450 $5,850	 $283 $283	 0 63 0 63	 7 3 2 7 3 2
4	Improvement of thermal insulation of the boilers - for one boiler - for four boilers	 0 0	 725 1,450	 $60 $120	 $100 $400	 1 67 3 33	 7 4 2 7 4 2
5	Installation thermal heat exchangers to utilize the heat from the combustion products leaving the boiler - for one boiler - for four boilers	 0 0	 32,400 64,800	 $2,660 $5,320	 $5,100 $20,400	 1 92 3 84	 7 4 3 7 4 3
6	System for sustaining constant outlet pressure at the old compressor station	50,000	0	$2,100	$1,950	0 93	7 2 5
7	Use of a speed-controlled electric motor for the compressor engines	171,600	0	$7,200	$30,000	4 17	7 2 3

The list of the possible frequency converters required for implementation of **ECO #1 "Implementation of energy management"** (Item 7 1)

- Portable gas analyzer *ENERAC 2000*

  Manufacturer Energy Efficiency System, Inc

  Bacharach, Cosa Instrument Corporation

- Portable thermometer for a non-contact measurements o temperature *DNS-26XL1* (0 to 1,000 °C)

  Manufacturers Davis Instruments,

  Wahl Instruments, Inc ,

  "Termoprylad"

The cost of the equipment gas analyzer - ***$5,000***, the infra-red thermometer -***$1,000***

The list of the equipment (see Fig 7 1) required to implement **ECO #2 "Controlling steam supply in to the bakery oven of *FTL-2*-type"**

- Humidifier, Armstrong, Size 94, 1" orifice, two manifold fittings No A-4967 - L, two 7' long manifolds, Honeywell modulating valve operator, input 4 - 20 mA, 24 V, 50 Hz Steam 0 14 to 0 82 barg (2 to 12 psig), 340 lbs/hr (170 m^3), one inverted No 800, 1/2" bucket trap, threaded openings to be metric sizes (DIN standard)
- Controller, *Davis Instruments*, Catalog No EH438048 , Model 48 VT, DIN PIN Controller, 220V, %) Cycle power input 4 to 20 mA, output 4 to 20
- Humidity sensor *Vaisala* model HMD 70U, 0 to minus 80 °C, 0 to100% RH output (4 to 20 mA) duct mounted with 24" long duct probe, 9 to 24 V, 50-cycle input power
- Transformer Honeywell AT88A1021, 220 V/24 V, 50 cycle, 50 VA

The cost of the equipment The humidifier - ***$3,700***, the humidity sensor and the controller – ***$850***, transportation – ***$455***

The total cost of implementation ***US $5,000***

The list of the thermal materials required to implement **ECO #3 " Improvement of the thermal insulation of bakery ovens of *FTL-2*-type"** (Item 7 3 2), **ECO #4 "Improvement of the thermal insulation of the boilers"** (Item 7 4 2)

- mats of basalt for thermal insulation - *TM 10-20, TM 10-15, MTPB, MBPa*

Manuafacturers JSC "Teploizoliaziya", Kyiv Region,
Town Settlement Kotsiubynske
Tel (04497) 72-306, 72-647
Thermal Insulating Materials Plant
Chenivtsi City,
CJSC "Izoliaziya",
Donetsk City
Tel (0622) 66-61-42

The list of the equipment required to implement **ECO #5 "Installation of a heat exchanger to utilize the heat of the combustion products leaving *E-1,6-0,9* Boiler** (Item 7 4 3)

- Economizer Cain Industries Model B12 1 unit
- assembled pump
  - 9GPM Pump, 12 feet head, 220 V, 50 Hz, 1 phase, 1/6 HP 1 unit
  - pump control system 1 unit
  - stack thermometer 2 units

- flow control valve 1 unit
- check valve 1 unit
- temp and relief valve 1 unit
- temperature and pressure relief valve 1 unit
- 80-gal storage tank 125 psi 1 unit

The manufacturer Cain Industries, Inc P O Box 189
Germantown, W1 53022 414-251-051
WATS1-800-558-8690
FAX1-414-251-0118

The list of the equipment required to implement **ECO #6 "System to keep constant the outlet pressure at the compressor station"** (Item 7 2 5)

- Control valve
- On-Off valve

The manufacturer JORDAN VALVE
3170 Wasson Road
Cincinnati, OH 4509-2381
USA

Fax 513/871-01-05

The list of the frequency converters that may be useful to implement **ECO #7 "Use of a controlled electric drive for the compressor engine"** (Item 7 2 3)

- *PChTE-75* Converter (TU U 02021420 001-95) designed for controlling the asynchronous electric motors with shorted rotors The nominal current of the frequency converter is 125 A, the nominal voltage of the frequency converter is 380 (400) V, the motor capacity is 75 kW, the overall sizes of the frequency converter (without a choke coil) are as follows $H \times L \times B = = 800 \times 400 \times 295$ mm, the oversize of the choke coil is $360 \times 275 \times 315$ mm

The address of the manufacturer Украина, 310125, г Харьков-125, а/я 5303
Научно-производственная компания ЭОС Лтд
Факс +(38) (0572)-26-11-01

or in English

Research and Production Company "EOS Ltd "
Post Box 5303, Kharkiv-125, 310125, Ukraine
Fax + 38 (0572) 26-11-01

- *AT 01* Frequency Converter (TU 3431-001-39460462-96 RF of 27 12 96)

The address of the manufacturer РФ, г Санкт-Петербург, ул Благодатная, 2

Корпорация "ТРИОЛ"

Факс (812)-296-93-38,

296-91-75

or in English

TRIOL Corporation

2, Blagodatnaya Str , Sankt-Petersburg, Russia

- *CX-INVERTER TP's 1997* Frequency Converters

CX0750V34F0N0 Converter, the overall sizes are $W \times H \times D = 250 \times 800 \times 315$ mm, the weight is 60 kg

The address of the distributor 252057, Украина, ул Желябова, 8/4

HONEYWELL

or in English

HONEYWELL, 8/4, Zheliabov Str ,

Kyiv-57, 252057, Ukraine

Fax +(380 (44) 446-72-11

- *ACF601-0070-3* Transistor Converter for controlling the rotational speed of asynchronous electric motors The oversize $715 \times 304 \times 429$ mm, the weight is 50 kg

The address of the distributor 252103, Украина, бул Дружбы Народов, 28

ABB Украина

or in English

ABB Ukraine

28, Druzhby Narodov Blrd ,

Kyiv, Ukraine

Fax +(380)(44) 295-13-98

- *TTE* Converter for controlling the rotational speed of asynchronous motors

  The address of the manufacturer 3306006 Украинаб г Запорожье, ГСП-187,
  ул Кремлевская, 63-А

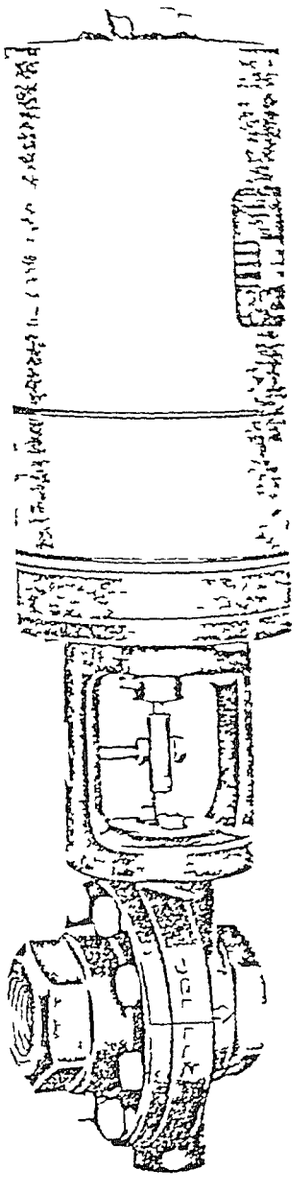
  or in English

  63-A, Kremlevskaya Str ,
  Zaporizhzhia, GSP-187, 330600, Ukraine
  Fax +(380) (44) 52-60-09

The approximate cost of the converter with the accessories plus the transportation cost

- $*7,207* for the converters produced in Ukraine,
- $*10,811* for the converters produced in the USA

Mark 37 Final Control Element



An electric motor actuated control valve for use as the final control element for distributed process micro-processor based control systems.

- Continuous duty, bi-directional rotary actuator can be set up for potentiometer command, on-off control, or electronic proportional control.
- Actuator available in 115 vac or 24 vdc configurations.
- AC units have dual balanced windings and a tuning capacitor for phase shift and reversal of direction.
- Totally enclosed, permanently lubricated gear train.
- Actuator available with NEMA 4, 7, 9 or 12 enclosures.
- Sliding gate seats provide:
  - straight through flow for reduced turbulence and quiet operation.
  - short stroke for fast response and accurate control.
  - easily interchangeable Cv's.
  - tight shutoff.
- Compact dimensions allow easy installation — ideal for tight space requirements.
- Available in sizes 1/4" through 6".

Your Local Representative

JORDAN VALVE
Division of Richards Industries
3170 Wasson Road Cincinnati OH 45209 2381
513/533 5600 • Fax 513/871 0105
Phone Toll Free
800/543 7311 (USA) 800/354 0305 (Canada)

BEST AVAILABLE COPY

BEST AVAILABLE COPY

Mark 37 Electric Motor Actuated Final Control Element

Description

The Mark 37 from Jordan Valve is an Electric Motor Actuated Control Valve with accuracy levels that make it the ideal choice for use as the final control element in any distributed process control system.

Featuring a sealed, lubricated, self-contained actuator, the motor is available in 115 VAC or 24 VDC configurations and has a permanently lubricated spur gear train with a stainless steel ball bearing supported output shaft. The motor is enclosed in a NEMA 12 aluminum housing with threaded conduit entry (Factory Mutual Approved) with optional NEMA 7 & 9 enclosures available.

Adding to the accuracy provided by the electric actuator are the sliding gate seals which provide a linear action to the stroke length. Actuator to the header connection. The sliding gate seals are composed of a molding gland and are a chain-like mechanism which provides reduction for low passage. While the gland molds free under steam pressure and ease of sliding guides combined with the disc and plate in constant contact eliminating noise and providing smooth performance.

Valve Specifications

Sizes 1/4 through 6

End Connections

- 1/4 through 2" threaded (NPT) union or companion flanges
- 2 1/2" through 6 - integral flanges

Materials

- Body ductile iron (1/4 6) bronze (1/4 2) carbon steel (1/2 6) stainless steel (1/2 6) cast iron (2 1/2" - 6)
- Trim SS/BRZ for CI DI & BRZ body valves 303SS for CS body valves 316SS for SS body valves
- Seats 303SS 316SS Jordanic Jordanite Teflon Coated
- Packing spring loaded Teflon (500 F max) Grafoil (above 500 F)

Service steam water air oil gas chemicals

Flow Characteristic linear (std) equal percentage (specify model MK377 for equal percentage)

Shutoff ANSI Class IV

Body Rating ductile iron up to 988 psi and 650 F bronze up to 500 psi and 500 F carbon steel and stainless steel up to 1440 psi and 650 F depending upon specific construction Temperature limit of 20 F on all materials for other temperatures and materials consult factory

Mounting in any position except in a vertical pipe where the flow moves in an upward direction

Motor Specifications

115 VAC Single Phase Continuous Duty

- Running Current [illegible] amps
- Stall Current [illegible] amps

24 VDC Permanent Magnet Continuous Duty

- Running Current [illegible] amps
- Stall Current [illegible] amps

Enclosures

- NEMA 12 Inside Industrial (Standard)
- NEMA 4 Water Tight (Optional)
- NEMA 7 & 9 Explosion Proof (Optional)

Ambient Temperature Limit

- AC Motor [illegible] F
- DC Motor 100 F also applies to AC motors in high duty cycle

Net Loading Effect on Electronic Controller

- 2700 ohms (1 5 mA)
- 470 ohms (4 20 mA)
- 270 ohms (10 50 mA)

Options

- Auxiliary Switches
- Two wire 4 20 mA Position Transmitter
- Internal Heater (for potential freezing services)

Control Signal Specifications

Standard Input Signal On/Off

Optional Input Signal (Requires Amplifier)

Resistance Command 0 1000 ohms

Current Command

- 1 5 mA DC
- 4 20 mA DC
- 10 50 mA DC

Split ranges available on request

Voltage Command

- 0 24 VDC
- 0 10 VDC

Amplifier Enclosures (Optional)

- NEMA 12 Inside Industrial
- NEMA 4 Water Tight
- NEMA 7 & 9 Explosion Proof

Note internal amplifiers are available for AC motor in 4 20 mA for DC motors in 4 20 mA or 0 10 vdc panel mounted amplifier also available

BEST AVAILABLE COPY

Mark 37 Electric Motor Actuated Final Control Element

Cv Values and Max Allowable Differential Pressures

C	S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			[illegible]			[illegible]		
			[illegible]			[illegible]		
			Time	Max	Max DP	Time	Max	Max DP
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8-6	[illegible]	Standard	[illegible]	75	75	6 2	175	175
		Jo danic		600	500		600	600
		Jo dani e		[illegible]	[illegible]		[illegible]	[illegible]
		Te Coa ed		600	600		600	600
2 5 4 4	1 2 & 3 4	Standard	10 7	175	175	6 2	175	175
		Jo danic		600	450		600	600
		Jo danite		600	600		600	600
		Te Coa'ed		600	600		600	600
6 - 9 5	&	Standard	6	175	175	9 0	175	175
		Jo danic		600	600		600	600
		Jo dani e		600	[illegible]		600	600
		Te Coa ed		[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	2	Standard	[illegible]	75	75	0 9	75	75
		Jo danic		[illegible]	[illegible]		[illegible]	600
		Jo dani e		600	[illegible]		600	600
		Te Coa ed		550	[illegible]		[illegible]	600
25 00	2	Standard	18 8	175	75	10 9	175	175
		Jo danic		600	200		600	600
		Jo danite		600	600		600	600
		Te' Coa ed		550	550		600	600
85	2 2	Jo danite	75	250	250	43 7	600	600
		Te Coa ed		200	200		600	600
[illegible]	[illegible]	Jo dani e	75	200	200	[illegible]	600	600
		Te Coa ed		[illegible]	[illegible]		600	600
200	4	Jo danite	42 9	150	150	25	600	600
		Te' Coa ed		75	75		600	600
395	6	Jo danite	42 9	50	50	25	600	600
		Te' Coated		25	25		600	600

Notes

Low Flow Trim Available Contact Factory for Cvs

Optional fast motor available (for on/off 115 VAC service only)

Travel times will be less when differential pressure is less than maximum

For faster operating times consult factory

Dimensions

Ductile Iron or Bronze

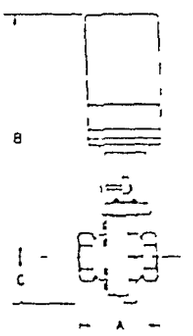
Valve Size	Dimensions in Inches A	B	C	D	Wt Lbs
1 4 3 8	3 8	10 7	2 00	4 50	18
1 2 3 4	3 62	14 09	2 12	4 50	18
1	4 2	14 07	2 62	4 50	20
1 2	4 50	14 54	2 62	4 50	2
2	4 50	4 7	2 62	4 50	20

Carbon Steel or Stainless Steel

Valve Size	Dimensions in Inches A	B	C	D	Wt Lbs
1/2 3 4	3 62	14 09	2 18	4 50	19
1	4 25	14 07	2 62	4 50	21
1 1 2	4 50	4 7	2 75	4 50	22
2	5 50	4 7	3 00	4 50	26

Flanged Valves

Valve Size	Flange Rating	Dimensions in Inches A	B	C	D	Wt Lbs
2 2	25 150 250 300	[illegible] 50	[illegible]	5 34	4 50	175
3	125 150 250 300	11 75 12 50	[illegible]	5 84	4 50	190
4	25 150 250 300	13 87 14 50	28 54	6 94	4 50	300
6	125 150 25 300	17 75 [illegible]	[illegible]	7 72	4 50	375



[illegible] es

for dimension B an additional 5 is needed to remove cover for electrical connection

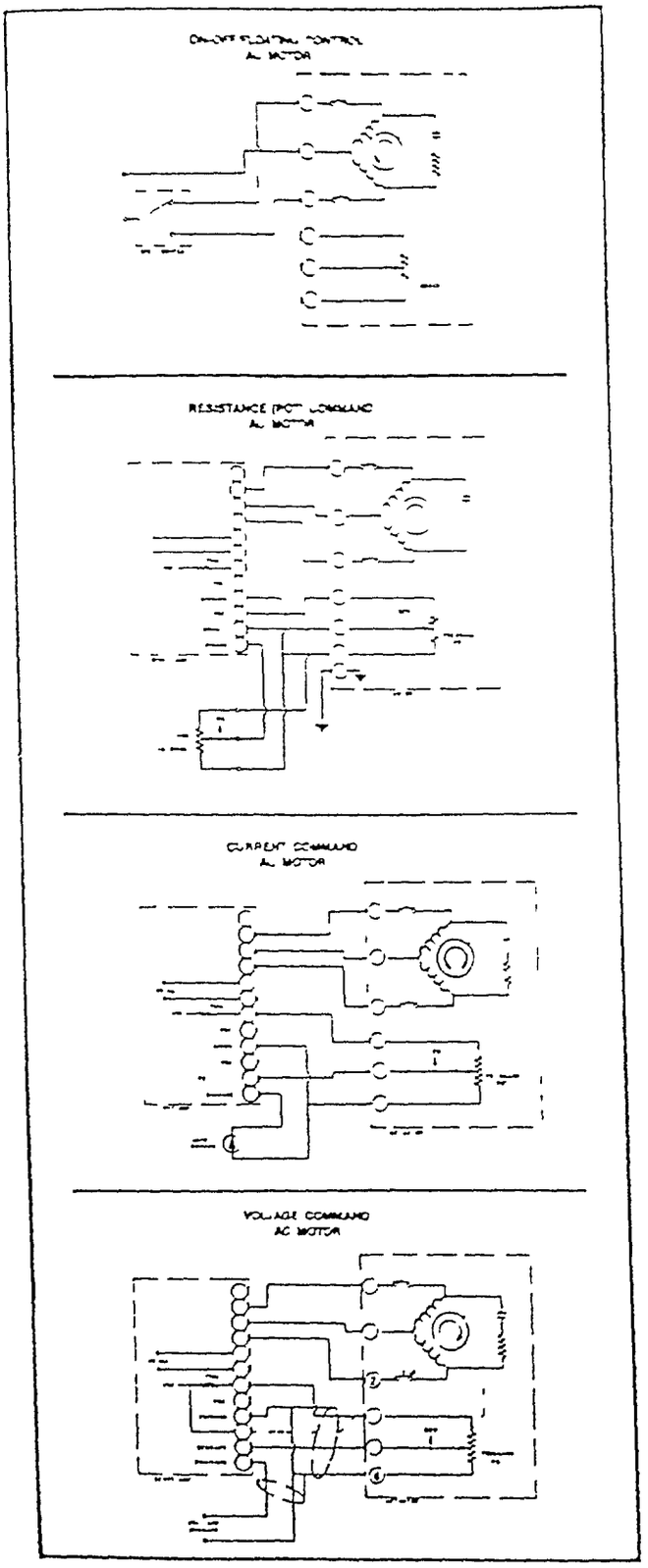
for explosion proof motor add 1 54 to dimension B and add 33 to dimension D

Flow Chart

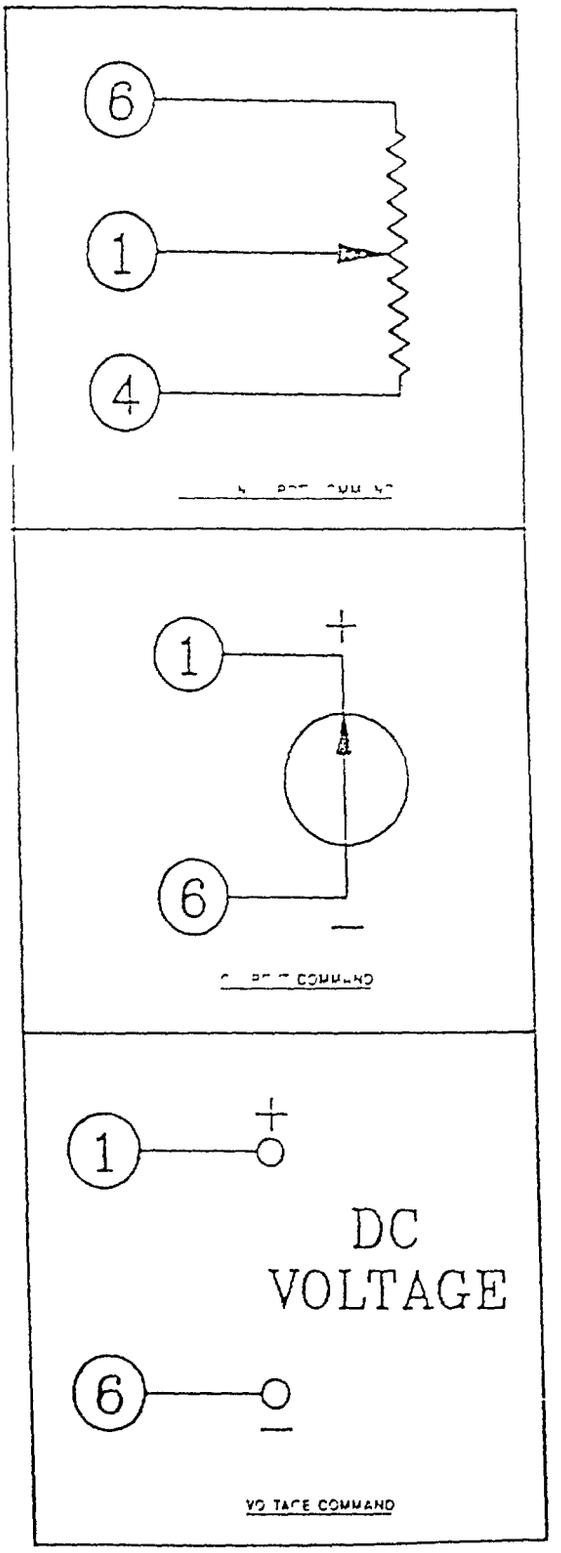
Valve Size	Cv @ Travel 10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	F_L
1/4	0 004	0 100	0 160	0 270	0 360	0 500	0 580	0 700	0 740	0 84	0 85
3/8	0 180	0 290	0 390	0 570	0 720	0 940	1 150	1 360	1 5 0	1 60	0 82
1/2	0 290	0 520	0 740	0 960	1 200	1 450	1 820	2 160	2 340	2 50	0 80
3/4"	0 580	0 890	1 270	1 580	1 930	2 480	3 020	3 540	4 090	4 40	0 77
1	0 970	1 460	1 920	2 500	3 170	3 870	5 180	5 700	6 310	6 40	0 75
1 1/4	1 240	2 000	2 710	3 490	4 360	5 300	6 360	7 280	9 340	9 50	0 72
1 1/2	1 390	2 490	3 680	4 760	6 140	7 850	10 30	13 10	14 60	15 0	0 69
2	2 580	4 340	6 210	8 470	10 80	13 80	18 30	22 70	24 80	25 0	0 67
	1 950	3 900	6 300	8 460	11 10	14 20	18 20	25 90	29 10	30 0	0 66
2 1/2	4 200	9 200	14 30	20 20	26 70	33 90	42 70	56 30	68 00	85 00	0 60
3	8 900	15 40	23 20	31 60	41 40	52 10	64 80	86 20	104 0	130 0	0 60
4	12 30	23 00	36 30	48 60	65 00	82 30	113 2	157 8	190 0	200 0	0 60
6	37 90	58 20	82 10	110 7	142 9	196 6	262 5	342 0	[illegible]	395 0	0 60

BEST AVAILABLE COPY

WIRING SCHEMATICS



DC MOTOR



BEST AVAILABLE COPY

BEST AVAILABLE COPY

SIZING DATA

SIZING FOR AIR AND OTHER GASES

NOTES ON USE OF AIR SIZING CHART

The following chart is based on the ... [illegible] ... in cubic feet per minute. For any ... [illegible] ... in the Chart ... [illegible]

... [illegible] ... Chart ... [illegible] ... Then move ... [illegible] ... Cv

To ... [illegible] ... the following formula:

$Q = N\sqrt{G_s}$

Q = Flow of Gas in SC[illegible]

N = [illegible] Chart ... in SC[illegible]

G_s = Spe[illegible] ... Gas

Formula to Convert ... [illegible] ... Standard ... [illegible]

$$SCF = ACF \times \frac{PSIA \times 520}{14.7\,(°F + 460)}$$

SIZING TABLE FOR AIR — With inlet temperature ... 60 °F ... IN STANDARD CUBIC FEET PER MINUTE SCF ... [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	5197 6180 162 8 [illegible]	[illegible]	23074 4371 24382 [illegible]	[illegible]	69999 7 069 24085 [illegible]															
7 0	[illegible]	80 [illegible] [illegible] [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	845 1872 2199 [illegible]	[illegible]	[illegible]	471 [illegible] 7779 779	8883 9054 9196 9196	[illegible]	[illegible]	[illegible]	[illegible]	18445 [illegible] 18717 18717	[illegible] [illegible] 19247 [illegible]	23826 24049 [illegible] [illegible]	31816 [illegible] 32046 [illegible]	3 966 36216 36226 36226	109281 [illegible] [illegible] [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18866 19315 19413 [illegible]	[illegible]	247 24767 [illegible] [illegible]	837 [illegible] 26315 [illegible]	1373 [illegible] [illegible] [illegible]	41938 [illegible] [illegible] [illegible]	47468 [illegible] 48069 [illegible]	72935 [illegible] [illegible] [illegible]

NOTE 1 Sizing p[illegible] ANSI ISA S75.01 [illegible] 977 a d [illegible] 1981

2 Figures in shaded blocks represent ... [illegible] ... conditions for sliding gate valves. Further decrease in outlet pressure will not ... [illegible] ... significant flow rate increase

[redacted]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	5600	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6300	7800	[illegible]	[illegible]	[illegible]

Приложение [illegible] на 4 стр., 1 экз.

Заместитель [illegible] [illegible] В.С.

[illegible]
593-229

BEST AVAILABLE COPY

55

[illegible] 221-0200 [illegible] [illegible] [illegible] [illegible] 40 [illegible]

ABB Frequency Converters

Транзисторные преобразователи для регулирования скорости вращения асинхронных электродвигателей насосов и вентиляторов

Трехфазное напряжение 380В, 400В, 415В

Тип преобразователя	IP 22		IP 54		Высота мм	Ширина мм	Глубина мм	Вес кг	Цена USD IP 22 без ЕМС фильтра	Цена USD IP 22 с ЕМС фильтром	Цена USD IP 54 с ЕМС фильтром
	Номин ток A	Мощн двигат кВт	Номин ток A	Мощн двигат кВт							
ACS601-0016-3	32	15	-	-	526	301	310	35	2 391	2 158	-
ACS601-0020-3	41	18.5	32	15					2 887	3 105	3 393
ACS601-0025-3	47	22	41	18.5					3 301	3 515	3 726
ACS601-0030-3	62	30	47	22	715	301	357	35	3 752	4 037	4 237
ACS601-0040-3	76	37	62	30					4 151	4 787	4 967
ACS601-0050-3	89	45	76	37					5 681	6 107	6 307
ACS601-0060-3	112	55	89	45					6 351	6 831	7 141
ACS601-0070-3	124	75(60)	112	55	715	301	429	50	7 245	8 047	8 377
ACS601-0100-3	178	90	-	-					9 666	10 350	
ACS601-0120-3	200	110(100)	-	-	860	480	429	89	11 197	11 989	
ACS607-0100-3	175	90	117	75					11 163	13 973	14 603
ACS607-0120-3	200	110(100)	178	90	860	480	429	89	13 119	16 819	17 469
ACS607-0110-3	260	132	200	110					16 675	21 476	22 306
ACS601-0170-3	316	160	260	132					19 093	24 581	25 751
ACS607-0210-3	395	200	316	160	2065	1030	611	370	21 258	27 169	28 509
ACS601-0260-3	480	250	395	200					23 771	30 271	31 763
ACS607-0330-3	570	315(270)	480	250	2065	1030	611	400	27 859	35 791	37 401

ЕМС фильтр - устройство уменьшающее влияние бросков тока от ACS 600 на питающей сети

Степень защиты - IP 22 и IP 54

В цену привода не входит НДС таможенный сбор страховка и транспортные расходы

АВВ Украина тел (044) 296 16 11
НПФ Эмтан тел (044) 111-26 66

BEST AVAILABLE COPY

[illegible]
Центр офис РСК г. Санкт-Петербург
ул. Благодатная 2
Тел./факс (812) 293338, 2969177,
2964880
[illegible]
ООО "Фундамент"
Украина 310057, г. Харьков
ул. Сумская 2
Тел./факс (0572) 124853, 127207

BEST AVAILABLE COPY

Triol

[illegible]

Преобразователи частоты вращения АТ 01 асинхронных электродвигателей [illegible] производства компании Триол

* Стоимость АТ 01 [illegible] включает в себя НДС. В таблице представлены цены в USD

Мощность двигателя, Вт	5	20	37	55	75	[illegible]	[illegible]	132	160	200
до 11 шт. разных моделей или до $50 000 за 6 месяцев	2000	2000	4290	5550	6090	[illegible]	2275	2705	15990	18990
от 11 до 24 шт. разных моделей или от $50 000 до $140 000 за 6 месяцев	2 [illegible]	2990	3950	599	749	995	295	855	4750	17090
более 24 шт. разных моделей от $140 000 за 6 месяцев	1990	2690	3590	5590	6800	8540	10250	13620	10090	15800

* Преобразователи могут иметь исполнение IP 21 или IP-54 (дополнительная согласованная доплата необходима)

** Сроки поставки согласовываются договорным в пределах 1-2 недель с момента оплаты в зависимости от размеров и характера поставки

[illegible]

[illegible]

[illegible]

[illegible]

Дополнительные возможности

[illegible]

[illegible]

[illegible]

[illegible]

BEST AVAILABLE COPY

Fax Transmittal

To	Быков Юрий
cc	
Company	
Fax	227 08 28
From	M Гоев
Date	12-2-97 10:57
Pages including this cover page	1

BEST AVAILABLE COPY

Message

Subject Инверторы

В таблице Вы видите две основные колонки – для аппаратов с постоянным моментом (конвейеры и т.д.) и с переменным (вентиляторы, насосы).
Хочу еще подчеркнуть, что при выборе инвертора важно выдерживать соответствие тока привода и инвертора (колонка ISQR – номинальный ток), это зачастую важнее чем просто подбор по мощности, тем более что для аппликаций с переменным моментом мощность инвертора может быть на ступень ниже, чем Вы видите в таблице. Степень защиты может быть другой – IP21, IP54.

Цена дана без учета НДС (+20%) и расходов на транспорт и страховку, а также на таможенные услуги (+10%).

Срок поставки – 4-8 недель.

С уважением и надеждой на взаимовыгодное сотрудничество

Гоев Михаил
Менеджер проекта

Honeywell
Zhelyabova 8/4
252057 Kiev
Ukraine
Tel 00380-44 241-91 94(95 96) 441-74-02(4 15)
Fax 00380-44-4467211
If you did not receive all pages or if document is illegible, please call our phone number

59

honeywell

OS NO | Constant torque | Variable torque | Encoder | [kg] | USD

Case 6 06 007

Phase 380 V

CX0122V34A2N0	2.2	6.5		3.0	8	M4	P20	120 x 290 x 2.5	7	55
CX0220V34A2N0	3	8.0	2	4.0	10	M4	P20	120 x 290 x 2.5	7	1025
CX0400V34A2N0	4	10	5	5.5	10	M4	IP20	20 x 290 x 2.5	7	490
CX0550V34A2N0	5.5	10	20	7.5	18	M4	P20	20 x 290 x 2.5	7	740
CX0750V34A2N0	7.5	19	27	11.0	24	M5	P20	157 x 405 x 2.5	4.5	2 34
CX0 10V34A2N0	11	24	36	15.0	30	M6	P20	157 x 405 x 2.5	4.5	2696
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2504
CX0185V34A2N0	18.5	42	56	22	48	M6	IP20	220 x 525 x 290	35	404
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	M6	IP20	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CX0370V34A2N0	37	75	3	40	90	M8	P20	220 x 525 x 2.5	35	7062
CX0450V34A2N0	45	90	30	56	0	M8	P20	220 x 525 x 2.5	35	055
[illegible]	[illegible]	[illegible]	[illegible]	75	[illegible]	M8	IP20	[illegible]	[illegible]	[illegible]
CX0750V34A2N0	75	150	225	90	80	M8	P20	250 x [illegible] x 2.5	60	2000
CX0900V34A2N0	90	180	250	110	210	M8	IP20	250 x 600 x 2.5	60	1490
CX 00V34A2N0	110	210	315	132	270	M8	P20	496 x 880 x 350	140	19405
CX 320V34A2N0	132	270	405	160	325	M10	IP20	496 x 880 x 350	140	23 65
CX 600V34A2N0	160	325	472	200	410	M10	IP20	496 x 880 x 350	140	27707
[illegible]	[illegible]	[illegible]	[illegible]	250	510	M8	IP20	700 x 1000 x [illegible]	200	3 660
CX2500V34A2N0	240	510	765	315	590	M8	P20	700 x 1000 x 2.5	200	0660
[illegible]	[illegible]	[illegible]	[illegible]	400	760	M10	IP20	880 x 1000 x 2.5	3 0	47000
[illegible]	400	760	900	500	840	M10	IP20	880 x 1000 x [illegible]	3 0	59 50

BEST AVAILABLE COPY

60

Telefax - Телефакс

Scientific production company EOS Ltd
Научно-производственное предприятие ЭОС Лтд
P. O. Box 6302, 310125 Kharkov-125 Ukraine - Украина 310125 Харьков-125 а/я 630
FAX - ФАКС ++380-572-261101

To - Куда US - D project
Dept Отдел
Attn - Кому Быхову Юрию Константиновичу

Fax No - N факса (044)2270625
Date - Дата 5.01.96
From - От кого Ю.Л. Шиндяев

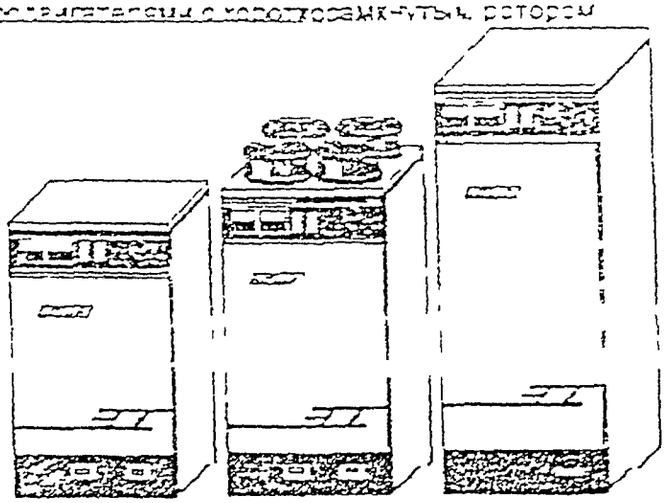
Ref - На Ваш Запрос по телефону

Уважаемый Юрий Константинович

Направляем Вам техническую информацию и цены на преобразователи частоты для асинхронного и синхронного электроприводов, которые могут быть поставлены в рамках программы USAID

Преобразователи частоты серии ПЧТЭ
для управления асинхронными электродвигателями 2.2-4000кВт

Преобразователи частоты ПЧТЭ (ТУ У 02021420.001-95) предназначены для управления асинхронными электродвигателями с короткозамкнутым ротором



30 кВт 75 кВт 160 кВт

На рисунке (Рис.1) показаны преобразователи частоты ПЧТЭ для электродвигателей мощностью 30, 75 и 160 кВт (габаритные размеры приведены в таблице)

Преобразователи частоты ПЧТЭ обеспечивают

- плавный пуск и торможение двигателей с регулируемым темпом,
- плавное регулирование в заданном диапазоне либо стабилизацию регулируемых параметров привода (скорость, момент)
- получение новых функциональных возможностей оборудования за счет автоматического регулирования технологического параметра (давление, расход)
- снижение усилий в обмотках двигателей, а также ограничение тока и момента в динамических режимах работы (пуск, торможение)
- рекуперацию (возврат энергии торможения привода в питающую сеть)

Преимущества ПЧТЭ

- синусоидальное выходное напряжение и квазисинусоидальный выходной ток

вода от преобразователя частоты,

- комплектная поставка с автоматическим выключателем, входным реактором и

BEST AVAILABLE COPY

2 Набор резервных ячеек и тиристоров	20% от установленных
3 Возбудитель	1 шт
4 Стенд для проверки ячеек	1 шт
5 *Реактор бетонный РБ 10-630-0,56	3 шт
6 *Сглаживающий дроссель СРОМ 1000	2 шт
или СРОС 200 (L=0,15мГн, I=65А)	2 шт
Цена (без реакторов и дросселей)	145 000 долл США

HVC-6,6

1 Преобразователь частоты HVC-6,6 - 1 шт	
2 Набор резервных ячеек и тиристоров	20% от установленных
3 Возбудитель	1 шт
4 Стенд для проверки ячеек	1 шт
5 *Реактор бетонный РБ 10-630-0,56	3 шт
6 *Сглаживающий дроссель СРОМ 8000	2 шт
или СРОМ 1600	1 шт
Цена (без реакторов и дросселей)	165 000 долл США

HVC-10/4,0

1 Секция выпрямителя 1 шт	
2 Секция инвертора 1 шт	
3 Набор резервных ячеек и тиристоров	20% от установленных
4 Возбудитель	1 шт
5 Стенд для проверки ячеек	1 шт
6 Стенд для подбора тиристоров	1 шт
7 *Реактор бетонный РБ 10-630-0,56	1 шт
8 *Сглаживающий дроссель СРОМ 1000	2 шт
Цена (без реакторов и дросселей)	190 000 долл США

HVC-10/10

1 Секция выпрямителя 1 шт	
2 Секция инвертора 1 шт	
3 Шкаф управления 1 шт	
4 Набор резервных ячеек и тиристоров	20% от установленных
5 Возбудитель	1 шт
6 Стенд для проверки ячеек	1 шт
7 Стенд для подбора тиристоров	1 шт
8 *Реактор бетонный РБ 10-630-0,56	3 шт
9 *Сглаживающий дроссель СРОМ 8000	2 шт
или СРОМ 15000	1 шт
Цена (без реакторов и дросселей)	235 000 долл США

*) В состав поставки не входит, однако, по согласованию с заказчиком фирма берет поставку на себя

Высоковольтные пусковые устройства серии HVS

HVS-6/2

1 Тиристорное пусковое устройство HVS-6/2	
2 *Шкаф высоковольтных контакторов (ШВВ)	
3 *Шкаф релейный (ШР)	
*)Поставляется по согласованию с заказчиком	
Цена (без ШВВ и ШР)	23 000 долл США
Цена полного комплекта 28 000 долл США	

HVS-6/5

BEST AVAILABLE COPY

Высоковольтные пусковые устройства серии HVS

HVS-6/2

1 Тиристорное пусковое устройство HVS 6 2
2 *Шкаф высоковольтных контакторов (ШВВ)
3 *Шкаф релейный (ШР)
*)Поставляется по согласованию с заказчиком

Цена (без ШВВ и ШР) 23 000 долл США
Цена полного комплекта 28 000 долл США

HVS-6/5

1 Тиристорное пусковое устройство HVS-6/5
2 *Шкаф высоковольтных контакторов (ШВВ)
3 *Шкаф релейный (ШР)
*)Поставляется по согласованию с заказчиком

Цена (без ШВВ и ШР) 26 000 долл США
Цена полного комплекта 31 000 долл США

HVS-10/3,2

1 Тиристорное пусковое устройство HVS-10/3 2
2 *Шкаф высоковольтных контакторов (ШВВ)
3 *Шкаф релейный (ШР)
*)Поставляется по согласованию с заказчиком

Цена (без ШВВ и ШР) 25 000 долл США
Цена полного комплекта 30 000 долл США

HVS-10/8,0

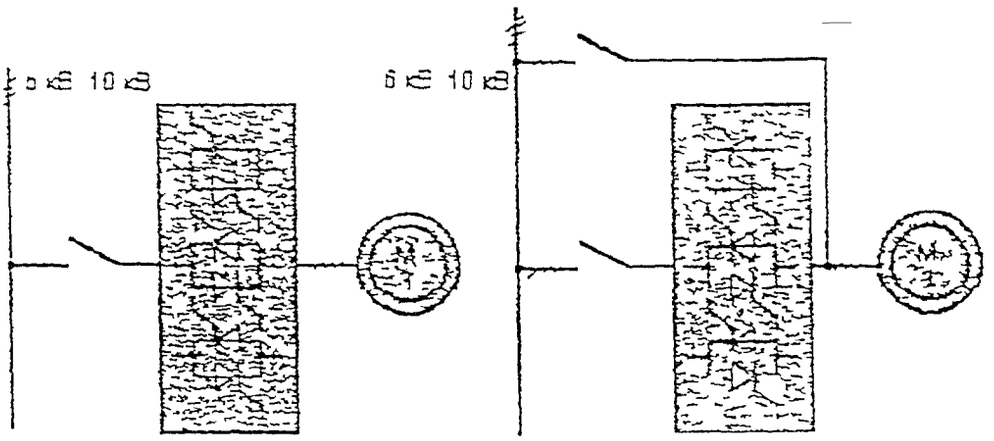
1 Тиристорное пусковое устройство HVS-10/8,0
2 *Шкаф высоковольтных контакторов (ШВВ)
3 *Шкаф релейный (ШР)
*)Поставляется по согласованию с заказчиком

Цена (без ШВВ и ШР) 30 000 долл США
Цена полного комплекта 35 000 долл США

BEST AVAILABLE COPY

При большом числе пусков [illegible] высоковольтных электродвигателей [illegible] срок их службы достигается экономии электроэнергии Эти помогут регуляторы напряжения серии HVS

Тиристорные высоковольтные регуляторы [illegible] позволяют [illegible] для управления высоковольтными [illegible] переменного тока



Регуляторы используемые для управления двигателями переменного тока обеспечивают

- плавный пуск двигателя с регулируемым темпом изменения скорости
- плавный останов двигателя с регулируемым темпом изменения скорости
- снижение потерь в двигателе при его разгрузке,
- ограничение пусковых токов в питающей сети
- повышение качества электроснабжения синхронных двигателей и ресинхронизацию после исчезновения и последующего восстановления напряжения сети
- повышение долговечности двигателей за счет снижения электродинамических усилий в обмотках двигателей при пусках,
- повышение долговечности коммутационной аппаратуры

Регуляторы в цепях мощных трансформаторов исключают броски тока при включении

HVS используются в качестве регуляторов в статических компенсаторах реактивной мощности

HVS могут использоваться как универсальные коммутационные и регулирующие устройства для высоковольтных установок

HVS в цепях защиты обеспечивают существенное снижение требований по коммутационной мощности аппаратов отключающих цепи короткого замыкания

BEST AVAILABLE COPY

Основные данные регуляторов напряжения HVS приведены в таблице

Тип	Номин напряжен кВ	Мощность двигателя, кВт	Габариты Н×Д×В мм
HVS-6/2,0	6	0,60 0,8 1,0 1,25 1,6 2,0	2200×700×800 (2800) с вентилятором
HVS-6/5,0		2,5 3,2 4,0 5,0	2000×1400×1000 (2600) с вентилятором
HVS-10/3,2	10	0,60 0,8 1,0 1,25 1,6 2,0 2,5 3,2	2200×1000×800 (2800) с вентилятором
HVS-10/8,0		4,0 5,0 6,3 8,0	2200×1400×1000 (2800) с вентилятором

Проходная номинальная мощность HVS в зависимости от номинального значения токов и напряжений находится в пределах 2000 - 10000 кВА. При отсутствии перегрузок допустимо регулирование полной мощности потребляемой нагрузкой, от нуля до номинального значения

При наличии перегрузок не выше 2,5 In допускается работа HVS с током постоянной времени нагрева трансформатора устройства (2 мин)

Рекомендуется следующее правило проверки допустимости перегрузки HVS среднеквадратичное значение тока за время 10 мин не должно превышать номинального значения тока устройства

BEST AVAILABLE COPY

65

BEST AVAILABLE COPY

ЦЕНЫ НА АСИНХРОННЫЕ ЭЛЕКТРОПРИВОДЫ ПЧТЭ

Цены франко-завод (EXW) включая НДС 20% Действуют с 1.01.98

Низковольтные электроприводы (0.4 кВ)

Мощность двигателя, кВт	Цена преобразователя частоты, долл. США
до 15	2400
22	2820
30	3720
37	4140
45	4680
55	5280
75	6120
90	7956
110	9840
132	10740
160	14100
200	16620
250	19800
315	25080

В состав и цену преобразователя частоты входит собственно преобразователь с тормозным дросселем и автоматический выключатель. В состав поставки входят также сельсин 100 и с отдельным управлением цена 275 долл. США (ячейка комплект с новых полупроводниковых модулей по 30 кВт каждого типа) для преобразователей мощностью до 75 кВт ценой 140 долл. США, 90-315 кВт 780 долл. США, а в случае необходимости может поставляться технологическая радиатор цена 40 долл. США и входные реакторы, тип которых определяется на стадии проектной привязки.

Высоковольтные электроприводы (0,66 - 6, 10 кВ)

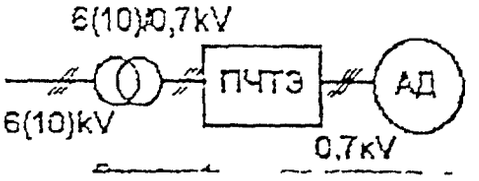
Возможны два варианта включения (см. прил.). Наиболее предпочтительным является вариант с одним входным [illegible]

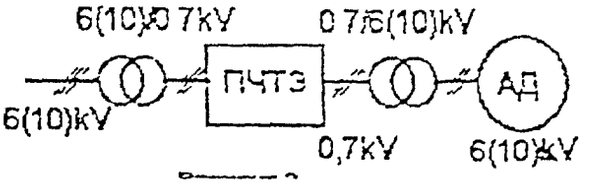
Мощность двигателя, кВт	Цена преобразователя частоты (комплект)	Цена трансформатора СП АВБ, г. Хмельницкий	Ориентировочная цена двигателя напряжением 0,66 кВ *
	Цена долл. США		
400	39000	16680	18000
500	48000	18080	22000
630	53000	19800	24000
800	60000	19800	24000
1000	80000	28080	33000
1250	98000	28080	**
1600	115000	**	**
2000	145000	**	**
2500	180000	**	**
3200	230000	**	**

Примечания *) ориентировочная цена без НДС для двигателя на 1500 об/мин

**) сообщается дополнительно по запросу

Приложение





ЭНЕРГОСБЕРЕГАЮЩИЕ ТЕХНОЛОГИИ

[illegible] НУС для управления

Технические характеристики

Тип	Номин напряжен кВ	Мощность номинальная МВт	Габариты шкафа, H×L×B, мм
HVC-6/2,5	6	0,63 0,8 1,0 1,25 1,6 2,0 2,5	2200×3600×800 (2800) с вентилятором
HVC-6/6,3		3,2 4,0 5,0 6,3	2200×5400×1000 (2800) с вентилятором
HVC-10/4,0	10	0,63 0,8, 1,0 1,25 1,6 2,0 2,5 3,2 4,0	2200×4800×800 (2800) с вентилятором
HVC-10/10,0		5,0 6,3 8,0 10,0	2200×7400×1000 (2800) с вентилятором

Электропитающие предназначены для работы в районах с умеренным холодным климатом (климатическое исполнение УХЛ1) при температуре от −1°С до +40°С относительной влажности не более 80% при температуре +25°С, а также в районах с тропическим климатом (климатическое исполнение О4)

TOTAL P.01

BEST AVAILABLE COPY

[illegible] и до [illegible] в [illegible] силовой части

Основные данные преобразователей частоты ПЧТЭ

Тип	Iном.ПЧ А	Uном.ПЧ В	Рдвиг, кВт	Габариты ПЧ (без дросселя) Н*L*В мм	Габариты дросселя (шкафа дросселя) Н*L*В или Д*Н мм
ПЧТЭ-15	до 30		2.2, 3,7 5.5 7.5 11 15	630 400*295	360*295 195
ПЧТЭ-22	50		18.5 22	800 400*295	360*275*215
ПЧТЭ-55	100		30 37 45 55	800 400 295	360 275 315
ПЧТЭ-75	125	380 (400)	75	800*400*295	360*275*315
ПЧТЭ-132	250		90 110 132	1000*425*400	450*500 740
ПЧТЭ-200	360		160 200	1000*425*600	430*500*740
ПЧТЭ-315	550		250 315	400 [illegible] 500	630 630 790
ПЧТЭ-500	500		400 500	1800*1500*800 (2320) с вентилят	630*630*790
ПЧТЭ-1000	1000	660 (710)	600, 800, 1000	1800*2400 800 (2320) с вентилят	2 шт 630 630*790
ПЧТЭ-2000	2000		1250 1600, 2000	2200*2400*800 (2720) с вентилят	2 шт 630*630*790
ПЧТЭ-4000	4000		3200, 4000	2200*4800*800 (2720) с вентилят	По согласованию

Право на изменение габаритных размеров резервировано

Для высоковольтных двигателей предлагаются варианты поставки электропривода структурные схемы которых приведены на рис 3 и 4 общепринятые в мировой практике

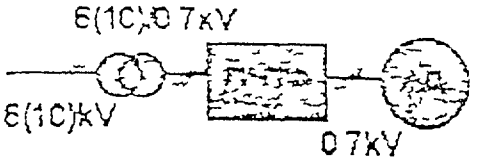


Рис 3

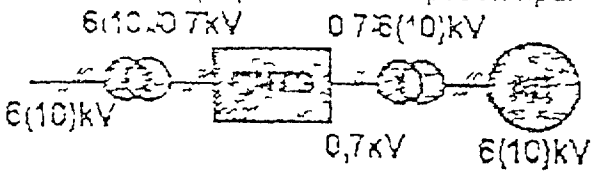


Рис 4

Сухие трансформаторы производства СП "АВВ Украина" (г.Хмельницкий) или Уралэлектротяжмаш (г Екатеринбург) Двигатели на 660 В могут быть изготовлены в г Санкт-Петербурге

Надеемся на взаимовыгодное сотрудничество

С уважением

Директор Ю.Л Шинднес

BEST AVAILABLE COPY

синхронными двигателями мощностью до 20 000 кВт

Тиристорные электроприводы по схеме вентильного двигателя предназначены для регулирования частоты вращения механизмов с приводными синхронными двигателями на напряжением 6 и 10 кВ и мощностью от 2 до 20 МВт.

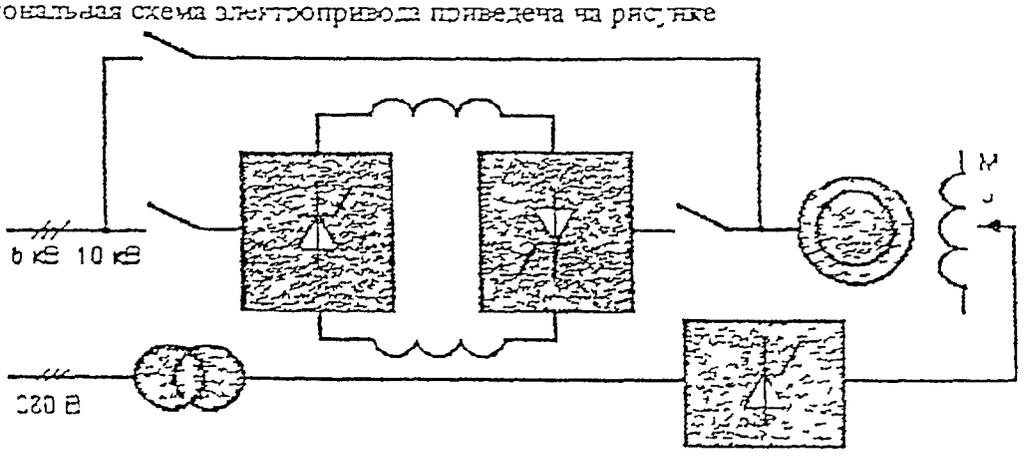
Применение этих электроприводов ПТС позволяет значительно экономить электроэнергию (от 25 до 60%), сохранять механизмы и приводные электродвигатели от ударных пусковых моментов, защитить питающие сети от больших пусковых токов, эксплуатировать механизмы в системах со слабыми сетями, автоматизировать и оптимизировать технологические процессы.

Наибольший эффект достигается при использовании этих электроприводов в механизмах с вентиляторной характеристикой нагрузочного момента - вентиляторах, дымососах, воздуходувках, центробежных насосах, компрессорах, требующих регулирования частоты вращения, в статических пусковых устройствах для частотного пуска с ограничением пускового тока и точной автоматической синхронизацией с питающей сетью крупных синхронных машин - турбо и гидрогенераторов, обратимых агрегатов гидроаккумулирующих станций.

Электроприводы обеспечивают:

- плавный частотный пуск приводного синхронного двигателя,
- регулирование частоты вращения приводного двигателя в диапазоне 0,
- длительную работу с установившейся частотой вращения в пределах указанного диапазона регулирования, стабилизацию установившейся частоты вращения,
- торможение приводного двигателя с рекуперацией энергии в питающую сеть,
- повторное включение электропривода при вращении электродвигателя на выбеге в рабочем диапазоне частот вращения,
- автоматическую синхронизацию приводного двигателя с питающей сетью,
- ограничение тока и момента приводного двигателя в установившихся и пусковых режимах.

Функциональная схема электропривода приведена на рисунке.



В состав электропривода входит входные и при необходимости выходные токоограничивающие реакторы, сглаживающие реакторы, силовой щит выпрямителя, силовой щит инвертора, шкаф управления, управляемый возбудитель.

BEST AVAILABLE COPY

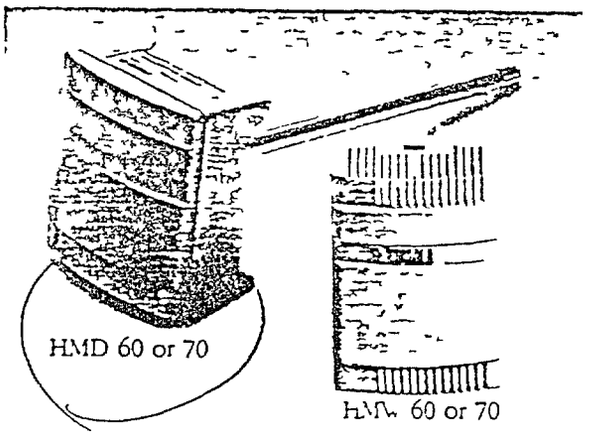
BEST AVAILABLE COPY

VAISALA

60/70 Series Duct and Wall-Mount Humidity and Temperature Transmitters for HVAC/EMCS

FEATURES/BENEFITS

- full 0 100 %RH measurement
- true two wire transmitters with 4 20 mA loop powered output (HMD 60 and HMW 60)
- selectable signal output of 0 1 V 0 5 V 0 10 V (HMD 70 and HMW 70) or one current module also 0 20 mA (HMD 70)
- electromagnetically compatible
- temperature compensated
- excellent long term stability
- up to ± 2 %RH accuracy
- HUMICAP® humidity sensor for excellent accuracy and long term stability negligible hysteresis and resistance to dust and most chemicals
- ±2% RH accuracy (0 90%)
  ±3% RH accuracy (90 100%)
- NEMA 4 housing (duct unit only)



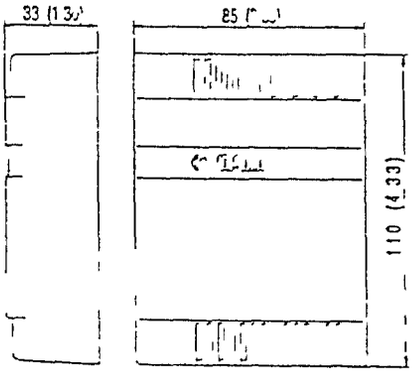
OPTIMAL ENERGY MANAGEMENT

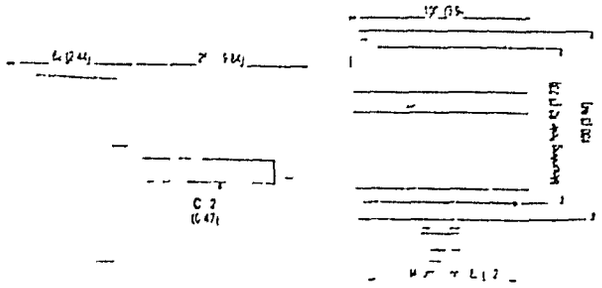
The duct and wall mounted HMD/W 60 and HMD/W 70 transmitters are designed for monitoring relative humidity and temperature in building energy management systems The combination of high accuracy stability and reliable operation makes these products the ideal choice for demanding energy management applications

The duct mount transmitters can also be used in many industrial humidity monitoring applications where their stability and resistance to chemicals and dust are of great value

A novel feature of these duct mount transmitters is the ability to remove the electronics without disassembling the unit from the duct

The HMD/W 60 and HMD/W 70 transmitters are available in two models U for humidity measurement only and Y for humidity and temperature measurement





FAST, ON SITE CALIBRATION

The accuracy of the transmitters is simple to check using the HMI 41 humidity calibrator The calibration can be done in seconds with a single potentiometer without disturbing operation This saves hours of maintenance time and ensures high system accuracy

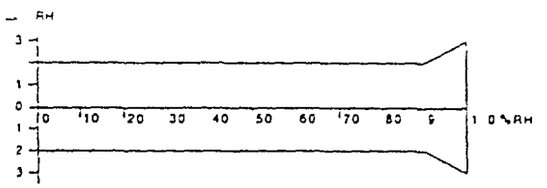
BEST AVAILABLE COPY

TECHNICAL DATA HMD/W 60 and 70 Series

60 Series 2 wire 4 20 mA output		
Wall mount	RH only	HMW60L
	RH & T	HMW60Y
Duct mount	RH only	HMD60L
	RH&T	HMD60Y
70 Series 3 wire variable voltage output		
Wall mount	RH only	HMW70L
	RH & T	HMW70Y
Duct mount	RH only	HMD70L
	RH & T	HMD70Y

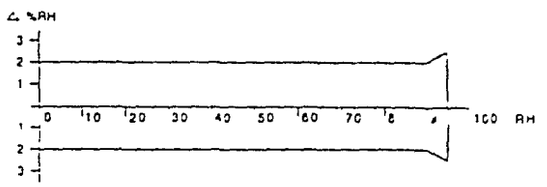
Relative Humidity (duct mount models)

Measurement range 0 100 %RH
Accuracy at +20 °C (68 °F)

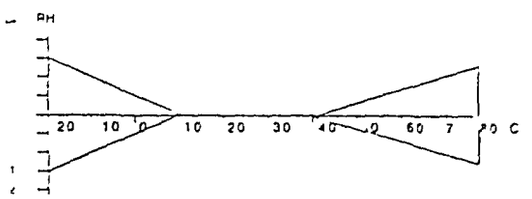


Relative Humidity (wall mount models)

Measurement range 0 95 %RH
Accuracy at + 20 °C (68 °F)



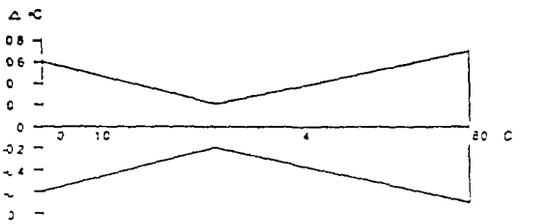
Temperature dependence



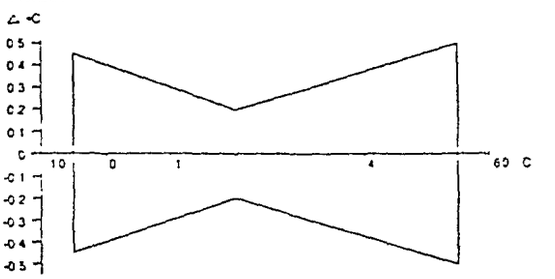
Response time at +20 °C
90% response 15 s (with membrane filter)
Sensor HUMICAP 180

Temperature (Y models only)

Linearity better than 0.1 °C
Sensor PT IEC 751 class B
(HMD 60Y and HMD 70Y)
Measurement range -10 +55 °C (+14 +176 °F)
Accuracy



(HMW 60Y and HMW 70Y)
Measurement range -5 +55 °C (+23 131 °F)
Accuracy



General - 60 series

Supply voltage 10 35 VDC (R_L = 0 ohm)
20 35 VDC (R_L = 500 ohm)
Output signal 4 20 mA

General - 70 Series

Supply voltage range depends on the selected output signal

	DC	AC
0 1V	10 35 V	9 24 V
0 5 V	14 35 V	12 24 V
0 10 V	19 35 V	16 24 V
0 20 mA (R_L = 0 ohm)	10 35 V	11 24 V
0 20 mA (R_L = 500 ohm)	20 35 V	17 24 V

General

Operating temperature range	
electronics	-5 +55 °C (+23 +131 °F)
sensor head (duct mount)	-20 +60 °C (-4 +176 °F)
Storage temperature range	-40 +80 °C (-40 +176 °F)
Housing	
sensor head (duct mount)	stainless steel
electronics (duct mount)	cast aluminum
electronics (wall mount)	ABS plastic
Connections	screw terminals 0.5 1.5 mm
Sensor protection (duct mount)	
standard	membrane filter (17039 HM)
option	stainless steel
	mesh filter (HM6670)

[illegible]

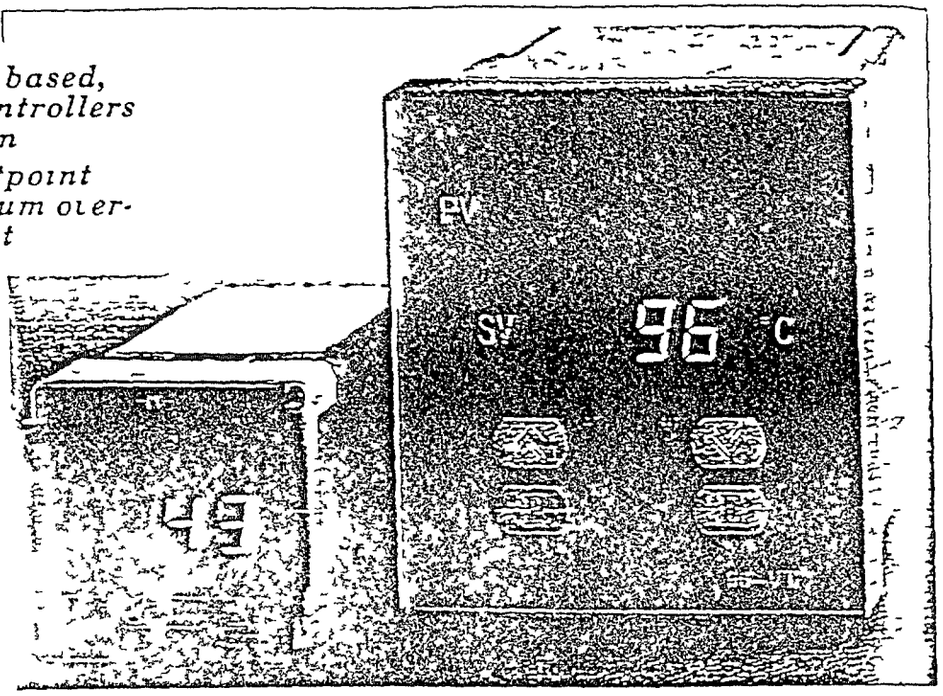
VAISALA
10 Commerce Way Woburn MA 01801
tel 617 933 4500 FAX 617 933 8029
(area code 781 in 1998)
[illegible]@vaisala.com

BEST AVAILABLE COPY

Temperature and Process Autotuning PID Controllers

Microprocessor based, dual display controllers with limit alarm

New ramp to setpoint versions minimum overshoot of setpoint



Common Features

- Dual 4-digit LED displays for process and setpoint values
- Control output and alarm LED indication
- Easy setup using user-friendly menus
- One-touch autotuning for precise control
- Built-in alarm delay countdown timer for activating alarm relay
- Anti-reset to minimize overshoot
- Accepts multiple thermocouple, RTD or process inputs
- Standard Limit Alarm relay(s) with 8 programmable modes
- Control outputs: 3 Amp relay, 24VDC to drive SSR or 4-20mA
- Screw terminal connections
- Non-volatile memory stores setting values in case of power failure
- Built-in diagnostics reduce troubleshooting time
- Complete with mounting hardware
- OEM Discounts available

48UTR & 96UTR Advanced Features

- Alarm relays have an adjustable dead band for dual control for heat/cool applications
- Auto/manual control modes
- Single step ramp back dramatically reduces overshoot of setpoint for "soft start"

ORDERING INFORMATION

Catalog No	Model	Description	Price
EH438048	48VT	¼ DIN PID controller with Limit Alarm	$182.00
EH438049	96VT	¼ DIN PID Controller with 2 Limit Alarms	209.00
EH438091	48UTR	¼ DIN PID ramp to setpoint controller	199.00
EH438092	96UTR	¼ DIN PID ramp to setpoint controller	229.00
96 models have 1 control output and 1 alarm relay. 48 models have 1 control output and 2 alarm relays			
Options			
EH438050	480996	¼ DIN to ¼ DIN Converter plate (enables user to mount ¼ DIN into any ¼ DIN panel cutout)	18.00
EH438051	RS-485	RS-485 Interface for 96VT (Cat# EH438048 only)	172.00
EH438511	48UT99	¼ DIN NEMA 12 soft bezel cover	7.00
TPM16	—	NIST Traceable Certificate	99.00
TPM17	—	NIST Traceable Certificate with Data	125.00
Must specify when ordering			
Input: 1) Temperature inputs (Thermocouple) 2) Temperature input (RTD) or 4-20mA input or 4) 1.5VDC input			
Output: 1) 5 AMP @ 110VAC relay output, 2) Pulsed 24VDC output or 4-20mA output			
When ordering a 4-20mA output add $72.00 to price			

SPECIFICATIONS ¼ DIN AND ¼ DIN MODELS

Ranges		
Type J	58 to 1830 F	50 to 1000 C
Type K	58 to 2498 F	50 to 1370 C
Type R	321 3182 F	0 to 1750 C
Type S	32 to 3182 F	0 to 1750 C
Type T	-454 to 752 F	270 to 400 C
RTD (Pt100Ω)	32 to 932 F	200 to 500 C
Thermocouple type E, B, E and N also available		
DC Process Inputs	4-20mA or 1-5VDC	
Accuracy	± 0.2% FS (including cold and setpoint)	
Sampling Time	0.25 seconds	
Control Action		
Proportional Band	0 to 100% (adjustable)	
Integral Time	0 to 3000 sec (adjustable)	
Derivative Time	0 to 3000 sec (adjustable)	
Cycle Time	1 to 100 sec	
Ramp Rate	0 100 C/min (only for ramping models)	
Hysteresis	0.0 to 25.5% (for ON/OFF control)	
Control / alarm relays	5A at 110VAC	
Operating Temperature	14 to 122 F (-10 to 50 C)	
Cutout	¼ DIN 1.77 x 1.77" (45 x 45mm) ¼ DIN 3.5 x 3.5 (91 x 91mm)	
Power	85 to 264 VAC 50/60 Hz	
Depth behind panel	4" (102mm)	

ISI STIPLEMENTS

BEST AVAILABLE COPY

Temperature/Humidity Dataloggers 328 329 342
Temperature Humidity Indicators .. 345-363
Temperature/Humidity Meters 235 320-330 332-337
Temperature/Humidity Pen 320
Temperature/Humidity Recorders 286-289, 324
Temperature/Humidity/Dewpoint Alarm 334
Temperature/Humidity/Dewpoint Meters 322, 333-337
Temperature/Humidity/Dewpoint Recorder 286, 341
Tension Load Sensor 972
Tesla Meter 956
Testers
- Cable Fault 166-169
- Capacitor 104
- Circuit 122 125
- Clamp-On Ground Resistance 158 159
- Component 100-105
- Continuity 122 124
- Deadweight 542 546
- Diode 104
- Ductwork Leakage 465
- Ground Resistance 158-162
- Hardness 934-936
- HVAC Leakage 455
- IC 108 109
- Insulation 50-66
- Leakage 465
- Line Phase 157
- Motor 117
- Paper Moisture 364
- Phase Sequence 117
- Receptacle 123-125
- Shock Pulse 762
- Soil Moisture 366 367
- Soil pH 811
- Viscosity 604, 824
- Voltmeter 152
- Wood Moisture 364-366

Thermal Anemometers 423-439
Thermal Reed Switch 228
ThermoAnemometer/Printers 428-431
ThermoAnemometers 423-439
Thermocouple Calibrator 260
Thermocouple Calibrators 370-377 390 393-410
Thermocouple Connectors 264
Thermocouple Dataloggers 300-306
Thermocouple Panel Meters 689
Thermocouple Probes 255-263
Thermocouple Recorders 290 292 298, 300-306
Thermocouple Switch Box 266
Thermocouple Wire 265
Thermohygrographs 286-289
Thermohygrometers 320-330, 332-337, 413
Thermometer Probes 255-263
Thermometers 182 284
Thermowells 263
Time Switches 979-982
Timers 979-982
Tool Kits 1001 1006
Torque Gauge 912 913
Total Dissolved Solids Meters 784-788
Totalizer Ratemeter 676 682
Toxic Gas Monitors 842-846
Transmitters 308-318
Turbidity Meters 800, 801

U

Ultrasonic Flow Meters 624-628
Ultrasonic Leak Detectors 896-904
Ultrasonic Liquid Level Monitors 642
Ultrasonic Measuring Meters 985-987, 994
Ultrasonic Micronometers 919-923
Ultrasonic Sensors 994
Ultrasonic Stethoscopes 896-904
Ultrasonic Thickness Gauges 919-923
Ultraviolet Radiometers 749, 750
Underground Cable Tracers 173-175
Underground Pipe Locater 175
Uninterruptable Power Supplies 85

V

Vacuum Gauges 503-514, 516, 518 522, 565
Vacuum Pumps 867
Vacuum Recorders 570
Vane Anemometers 413-423
Velometers 440 441
Vibrating Reed Tachometers 704
Vibration Meters 752 762
Vibration Monitors 759, 760
Vibration Recorders 765
Vibration Switch 768
Viscosity Testers 604 824
VLF Meters 957
Voice Dialing System 234
Voltage Detectors 120-125
Voltage Recorders 67 70
Voltage, Current, Power Datalogger 163
Voltmeter Tester 152
Volumetric Flow Meter 433

W-X

Wall Thermometers 236-238, 251, 263
Water Analyzers 766-808
Water Leak Detector 902
Water Level Meters 643 644
Water Pressure Recorders 572
Water/Waste Water Analyzers 797, 798
Wattmeters 137, 139 140
Weather Clocks 954
Weather Meters 940-954
Weather Stations 940-942
Weekly Timer 982
Wind Speed & Direction Indicators 940-944
Wind Speed Indicators 940-944, 950, 951
Wind Tunnels 456
Wire Circuit Tracing System 118
Wire Length Meter 121
Wire Sorter 123
Wiring Analyzer 125
Wood Moisture Testers 364-366
Work Lamps 1010
XY Xt Recorders 659
XY Yt Recorders 660

ORDERING INFORMATION

To Order
To place orders by phone, please call toll free (800) 368-2516 or use our toll free fax line (800) 433-9971

Customers may also reach Davis Instruments at these numbers:
Voice (410) 358-3900
Fax (410) 358-0252

Customers wishing to order by mail may do so by addressing the order to:
Davis Instruments
4701 Mount Hope Drive
Baltimore, Maryland 21215

When placing orders please specify
Billing Address
Shipping Address
Purchase Order Number
Catalog Number
and Description of Product
Quantity
Price

Hours of Operation
8:00 A.M. to 7:00 P.M. EST

Prices and Terms
The prices in this in this catalog are those in effect on the publication date and are subject to change without notice. Please call toll-free 1(800) 368-2516 to obtain current price quotations. Payment terms are net 30 days pending credit approval. C.O.D. shipments are available. Visa, MasterCard and American Express are accepted.

Shipping
All prices shown are FOB Baltimore, MD. Freight and handling charges are prepaid and added to the invoice. Orders are shipped via selected common carriers or you may request the carrier of your choice.

Confirming Orders
When making confirming orders please clearly label the order as a confirmation.

Quantity Discounts
Davis Instruments offers discounts on quantity orders. Please contact our Sales Department.

Return Merchandise
If you have the need to return a product for any reason, please contact our Customer Service Department. A return authorization number is required prior to shipping merchandise back to Davis Instruments. Davis Instruments reserves the right to apply a restocking charge where applicable.

Design Changes
Due to advances in technology some items may differ slightly from their description or appearance in the catalog.

Warranty
Davis Instruments shall not be liable for any injury, loss or damage, implied or statutory resulting out of the use or inability to use any item sold by us. Davis Instruments will replace or repair any item proved to be defective before using our instrumentation the customer must determine the applicability of the product for its desired use and the user must assume all risk in connection with it. Davis Instruments sells its products only under the terms and conditions stated above and will not be bound to terms and conditions stated by the purchaser in any offer acceptance, or other contractual document. Placing an order or accepting delivery of an item shall be considered acceptance of Davis Instruments terms and conditions.

WE ACCEPT

VISA MasterCard American Express

BEST AVAILABLE COPY

Application engineering service

Representative/Factory Assistance.
Armstrong Representatives have years of practical experience in solving humidification problems. What's more, they're experts at assessing your humidification needs. Backing the Representatives, of course, are Armstrong humidification specialists who are available to assist with difficult to unusual problems.

Armstrong Humidification Handbook.
A comprehensive, single-source reference, the Armstrong Humidification Handbook has become the standard for the industry.

Installation/Operation Manuals.
Armstrong provides detailed instruction materials to assist customers in the proper installation and operation of Armstrong steam equipment.

Application Data Sheets.
Thorough but concise application data sheets are provided by Armstrong for many of its steam products.

Computer and Sizing.
Given the basic parameters of an installation, Armstrong humidification specialists can use computers to quickly develop information for efficient humidification, especially when complex economizer systems are involved.

Show Facilities.
Armstrong conducts comprehensive steam energy conservation seminars at locations in the United States. Contact your Armstrong Representative for more information to schedule a seminar.

Limited Warranty and Remedy.
Armstrong Machine Works warrants to the original user that those products supplied by it and used in the service and in the manner for which they are intended shall be free from defects in materials and workmanship for a period of one (1) year after installation, but not longer than fifteen (15) months from date of shipment. Except as may be expressly provided for in a written agreement between ARMSTRONG and the user, ARMSTRONG DOES NOT MAKE ANY OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE.
The sole and exclusive remedy with respect to the above limited warranty or with respect to any other claim relating to the defects or any other condition or use of the products supplied by Armstrong, however caused and whether such claim is based upon warranty, contract, negligence, strict liability or any other theory, is limited to the repair or replacement of the part or product, excluding any labor or any other cost to remove or install said part or product or at Armstrong's option, to repayment of the purchase price. Notice of any such claim must be given, in writing, to Armstrong Machine Works, Three Rivers, Michigan 49093, within fifteen months after the first installation or use of the products. In no event shall Armstrong be liable for special, direct, indirect, incidental or consequential damages, including, but not limited to, loss of use or profits or interruption of business activity.

Armstrong

Steam Specialty Products
Armstrong Machine Works
USA: 816 Maple Street, Three Rivers, Michigan 49093 / Phone: (616) 278-1455
Europe: 3 Rue Hermann Lachapelle, B-4000 Liège, Belgium / Phone: (041) 526952

BEST AVAILABLE COPY

Armstrong Conditioned Steam humidifiers for air handling systems are manufactured in four sizes to meet the needs of centralized humidification. Operation and control may be pneumatic or electric. See page 8

Standard Package

All Armstrong Conditioned Steam Humidifiers are supplied in standard packages which include the following

Pneumatically Controlled (AM) Models

1 Humidifier with integral operator
2 Distribution manifold of length specified
3 Y type strainer
4 Armstrong inverted bucket trap

Electric Motor Controlled (EM) Models

1 Humidifier with integral operator
2 Distribution manifold specified
3 Y type strainer
4 Armstrong inverted bucket trap

Recommended Option

A thermostatic or electronic temperature sensor is offered as an optional extra and is recommended in any system where the steam supply to the manifold jacket and humidifier body may be interrupted or turned off

Table 11 1 Size 93 Continuous Discharge Capacities in lbs of Steam Per Hour
Capacities when Steam Supply is Through the Manifold See Figure 14 2A

Orifice Size In	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	45	50	55	60
3/32	70	84	100	110	121	132	139	148	153	160	169	173	180	185	212	246	270	297	330	356	384	413	441
1/16	77	95	108	125	129	138	146	155	169	176	189	196	204	213	246	286	332	336	363	401	432	464	497
3/32	83	122	130	145	150	157	167	180	193	202	211	225	230	235	282	319	[illegible]	385	416	447	480	517	546
1/8	99	128	145	160	172	185	198	202	217	228	242	253	264	272	321	354	407	435	460	500	540	581	621
5/16	103	137	159	185	196	208	225	238	258	266	271	283	291	300	360	408	[illegible]	515	562	614	661	719	753
3/8	117	147	175	202	213	234	252	274	289	296	317	336	347	369	428	488	547	607	664	726	785	847	900
7/16	127	174	203	232	255	287	300	338	361	374	382	409	426	459	548	607	745	848	924	996	1082	1179	1270

Table 11 2 Size 93 Continuous Discharge Capacities in lbs of Steam Per Hour
Capacities when Steam Supply is Direct to Separator (Manifold Trapped Separately) See Figure 14 2B

Orifice Size In	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	45	50	55	60
3/32	70	84	100	110	121	132	139	148	153	160	169	173	180	185	212	246	270	297	330	356	384	413	441
1/16	77	95	108	125	129	138	146	155	169	176	189	196	204	213	246	286	332	336	363	401	432	464	497
3/32	83	122	130	145	150	157	167	180	193	202	211	225	230	235	282	319	[illegible]	385	416	447	480	517	546
1/8	99	128	145	160	172	185	198	202	217	228	242	253	264	272	321	354	407	435	460	500	540	581	621
5/16	103	137	159	185	196	208	225	238	258	266	271	283	291	300	360	408	[illegible]	515	562	614	661	719	753
3/8	125	160	183	209	225	248	263	285	307	314	336	358	372	[illegible]	460	512	570	641	696	757	831	924	977
7/16	136	187	220	263	270	300	326	376	409	430	464	495	510	524	635	740	827	931	1017	1103	1195	1281	1366

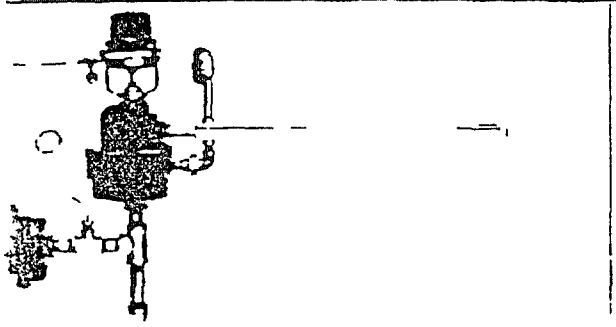
Table 11 3 Size 94, Continuous Discharge Capacities in lbs of Steam Per Hour
Capacities when Steam Supply is Through the Manifold See Figure 14 2A

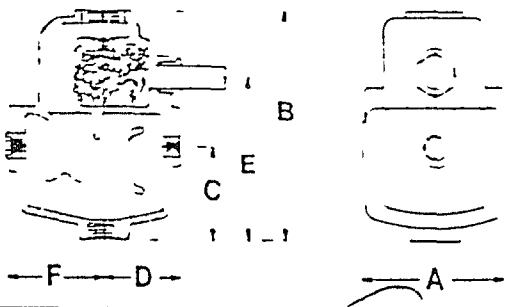
Orifice Size In	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30
1/8	137	167	190	[illegible]	[illegible]	251	[illegible]	[illegible]	312	[illegible]	350	[illegible]	[illegible]	414	478	541	606
3/4	185	227	258	[illegible]	[illegible]	340	351	391	425	445	474	505	525	556	684	772	859
7/8	243	297	338	378	425	446	473	513	553	581	621	672	[illegible]	758	873	[illegible]	1109
1	278	343	390	437	478	515	546	593	639	671	718	764	795	850	991	1104	1268
1 1/8	320	395	450	506	540	594	630	684	748	774	828	882	918	981	1117	1304	1469
1 1/4	344	418	475	553	570	627	665	722	795	817	874	931	969	988	1182	1391	1567
1 1/2	390	490	558	621	669	736	781	847	919	959	1026	1095	1137	1150	1396	1607	1816

Table 11 4 Size 94 Continuous Discharge Capacities in lbs of Steam Per Hour
Capacities when Steam Supply is Direct to Separator (Manifold Trapped Separately) See Figure 14 2B C

Orifice Size In	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	45	50	55	60
1/8	137	167	190	213	225	[illegible]	266	289	312	327	350	372	388	414	478	541	606	668	730	798	881	954	1017
3/4	198	242	275	308	330	363	385	418	451	473	506	539	561	607	707	790	893	982	1073	1175	1264	1357	1446
7/8	252	308	350	392	420	462	490	532	574	602	644	686	714	793	938	1017	1147	1270	1399	1537	1653	1781	1867
1	299	374	425	489	510	561	595	646	718	731	782	833	867	918	1075	1203	[illegible]	1528	1688	1835	1978	2118	2289
1 1/8	370	462	525	588	630	693	735	798	854	903	966	1029	1071	1134	1344	1512	[illegible]	1890	2100	2262	2468	2644	2822
1 1/2	413	517	588	661	700	776	826	890	959	1011	1081	1134	[illegible]	1260	1487	1722	[illegible]	[illegible]	2268	2607	2835	3053	3205
	540	675	750	840	900	990	[illegible]	1140	1260	1320	1500	1470	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3195	3675	3780	4070

entral station or booster humidifiers in ir handling systems (physical data, dimensions and capacities)





b'e 10 1 Physical Data

ensions Inches	Dimensions Inches	Dimensions Inches	Dimensions Inches
A 4 9/16	A 5 9/16	A 6 3/4	A 10 7/8
B 8 9/16	B 8 9/16	B 11 1/8	B* 17 1/8
C 3 3/8	C 3 3/8	C 4 1/8	C 6 7/8
D 3 1/16	D 3 13/16	D 4 3/4	D 8
E 6 1/16	E 6 1/16	E 9	E 12 5/8
F 3 13/16	F 3 13/16	F 4 3/4	F 8
eight lbs (less operator and manifold) 24	Weight lbs (less operator and manifold) 30	Weight lbs (less operator and manifold) 52	Weight lbs (less operator and manifold) 145
onnection Sizes	Connection Sizes	Connection Sizes	Connection Sizes
Steam Inlet 1/2	Steam Inlet 3/4	Steam Inlet 1 1/4	Steam Inlet 2"
Drain 1	Drain 1"	Drain 1 1/4	Drain 2
Drain Trap 3/4	Drain Trap 3/4	Drain Trap 3/4	Drain Trap 3/4
ain Trap Model 800	Drain Trap Model 800	Drain Trap Model 811	Drain Trap Model 812
dy Mounting Holes 3/8 x 16 (2)	Body Mounting Holes 3/8 x 16 (2)	Body Mounting Holes (2)	Body Mounting Holes (4)

[illegible] includes [illegible] Sheet Table 9 1 page 9

b'e 10 2 Size 91, Continuous Discharge Capacities in lbs of Steam Per Hour

ifice e In.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	45	50	55	6-
/16	1 3	1 7	2 0	2 3	2 6	2 8	3 0	3 2	3 4	3 6	3 8	4 0	4 2	4 [illegible]	5 6	6 5	7 7	8 4	9 2	0 0	11 0	11 8	12
[illegible]64	2 1	2 7	3 2	3 7	4 1	4 4	4 8	5 1	5 4	5 7	6 0	6 2	6 4	6 7	8 4	10 6	11 2	12 4	13 0	1[illegible] 8	16 0	17 8	1[illegible]
[illegible]32	3 0	3 9	4 6	5 2	5 8	6 3	6 8	7 3	7 8	8 2	8 6	9 0	9 3	9 6	11 9	13 4	14 3	17 2	19 2	21 2	22 8	23 7	2[illegible]
/64	4	5	6	7	8	8	9	10	10	11	11	12	12	13	16	18	19	21	24	2[illegible]	28	31	33
1/8	5	7	8	9	10	11	12	13	14	14	15	16	17	18	23	25	28	30	33	35	37	40	4[illegible]
5/32	8	10	12	14	16	17	19	20	21	22	23	25	26	27	31	36	40	44	48	52	56	60	6[illegible]
7/64	12	15	18	21	23	26	27	29	31	32	35	36	37	40	47	52	59	65	70	77	83	88	93
/32	16	21	25	29	32	35	37	40	42	44	47	49	51	53	62	70	84	90	98	103	113	126	135
1/4	22	28	33	38	[illegible]2	4[illegible]	[illegible]9	53	55	59	62	6[illegible]	67	69	82	91	102	115	125	135	150	160	1[illegible]
	26	32	38	43	47	50	[illegible]	58	61	64	67	70	72	75	8[illegible]	102	115	125	140	150	160	175	185
[illegible] 8	32	38	4[illegible]	50	5[illegible]	60	6[illegible]	6[illegible]	73	77	82	85	88	92	10[illegible]	23	134	148	167	19[illegible]	216	23[illegible]	2[illegible]
11/32	3[illegible]	43	50	55	[illegible]	72	76	81	85	90	94	97	103	108	127	1[illegible]7	172	190	209	230	248	267	27[illegible]
3/8	42	50	56	65	70	76	82	93	97	105	110	115	121	12[illegible]	15[illegible]	171	191	212	233	2[illegible]5	272	303	3[illegible]

b'e 10 3 Size 92, Continuous Discharge Capacities in lbs of Steam Per Hour

Orifice ize In.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	25	30	35	40	45	50	55	60
1/8	5	7	8	9	10	11	12	13	15	16	17	18	19	20	23	25	28	31	33	36	38	41	4[illegible]
[illegible]32	8	10	12	14	16	17	19	20	21	22	23	25	26	27	31	36	40	44	48	5[illegible]	56	60	6[illegible]
[illegible]16	12	15	18	21	23	26	27	29	31	32	35	36	37	40	47	52	59	65	70	77	83	88	9
7/32	16	21	25	29	32	35	37	40	42	44	47	49	51	53	62	70	84	90	98	103	113	126	135
/4	22	28	33	38	4[illegible]	46	49	53	55	59	62	64	67	69	82	91	102	115	125	135	150	160	170
9/32	27	35	42	48	53	58	63	6[illegible]	71	75	79	81	85	88	103	117	129	140	159	1[illegible]	190	199	[illegible]
5/16	33	43	51	59	65	71	77	82	87	92	97	100	104	108	127	1[illegible]4	159	172	197	212	228	[illegible]43	[illegible]
11/32	40	52	62	70	78	84	91	[illegible]	102	109	114	119	124	129	152	172	192	206	236	[illegible]	270	297	31[illegible]
3/8	53	59	65	78	[illegible]	9[illegible]	99		1 5	119	123	128	133	1[illegible]5	162	183	[illegible]05	276	[illegible] 6	[illegible]	[illegible]0	314	3[illegible]
6	74	84	90	99	[illegible]	11	123	1 1	136	143	150	159	164	1 0	19	[illegible]24	250	277	316	46	370	400	4
									0	1 9	186	1 3	6	19	[illegible]	[illegible]68	300	3 4	6	[illegible]	4 8	46[illegible]	4

Копеуже

Кому	Украина г Киев BURNS AND ROE , Господину Мамиагину В М
От кого	Трокоз Г А , Хоневедл-Украина г Киев
Дата	17/02/98 10 17
Количество листов	1

КОММЕРЧЕСКОЕ ПРЕДЛОЖЕНИЕ № 1 BURNS/MC от 19 02 98 г

Поз	Кол	Наименование и тип оборудования	Цена (USD)	Стоимость (USD)	ПРИМЕЧАНИЕ
1	2	Регулятор UDC –1500 Тип DC1503 7 1 0-0-1 0-0-0	330 00	660,00	
2	2	Электропривод Тип 4318-900 223	452 00	904 00	
3	2	Седельный клапан DN 50 (Фланцевое исполнение) Материал клапана – чугун	673 00	1 346 00	
4	2	Датчик влажности 0 120 C° 0 100 RH output 4 20mA	650 00	1 300 00	
5	1	Шеф-монтажные и пуско-наладочные работы	700 00	700 00	
ИТОГО стоимость одного комплекта оборудования					4 910,00 (USD)
ИТОГО стоимость 8-ми комплектов оборудования					39 280,00 (USD)

ПРИМЕЧАНИЕ 1 Цены приведены на условиях Ex-works
2 Стоимость страховки, упаковки и доставки оборудования на условиях CIP-Киев ориентировочно составит 500,00 USD для одного комплекта и 1 500,00 USD для 8-ми комплектов

С уважением ,

Г А Трокоз

Менеджер по продаже средств АСУ ТП

77

BEST AVAILABLE COPY

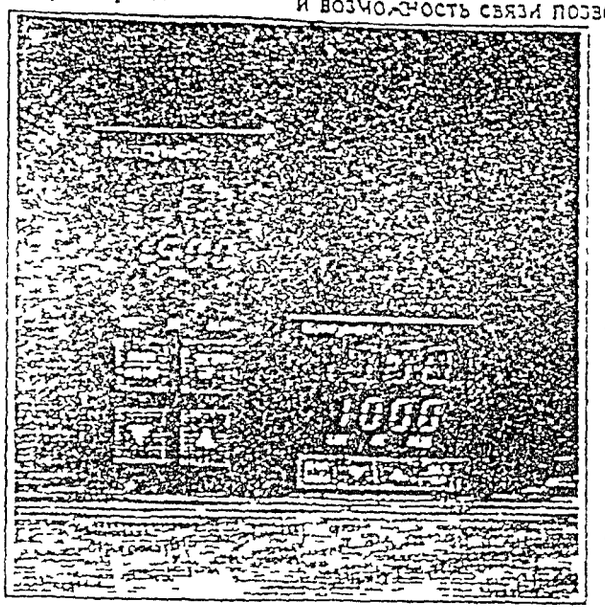
Honeywell

UDC 1000 и UDC 1500 серии Micro-Pro
Низкая цена и превосходные эксплуатационные характеристики в компактных цифровых контроллерах

Подтвержденное качество, точность и цена марки Honeywell

UDC 1000 и UDC 1500 Micro-Pro компактные 1/16 DIN и 1/8 DIN контроллеры на базе микропроцессоров, обеспечивают высокое качество и эксплуатационные характеристики фирмы Honeywell по низкой цене. Небольшой размер контроллеров делает их идеальными для применения в тех местах, где место под панель ограниченно, но важное значение имеют эксплуатационные характеристики и гибкость.

Основные особенности контроллера двойной дисплей, защищенная лицевая панель в соответствии с NEMA 4/IP66, универсальные входы и источники питания, до трех типов выходного сигнала (релейный, SSR, линейный), автоматический и ручной режим, автоматическое переключение, связь RS485 ASCII.



Низкая цена

Контроллеры UDC 1000 и UDC 1500 были разработаны чтобы предложить максимальные эксплуатационные характеристики по очень низкой цене.

Легкость конфигурирования

Два 4-разрядных дисплея и четыре тактильных клавиши обратной связи обеспечивают вам конфигурирование контроллера с минимальными затратами времени и усилий.

Высокая надежность плюс 2 года гарантии

Передовая технология производства контроллеров серии Micro Pro гарантирует соответствие высоким стандартам качества фирмы Honeywell. Контроллеры UDC 1000 и UDC 1500 обеспечены двухгодовой гарантией и сервисным обслуживанием в центре технической поддержки фирмы Honeywell.

Гибкость

Универсальные входы, универсальные источники питания и сменные факультативные карты (релейная, SSR, линейная и внешний интерфейс) позволяют сократить список комплектующих.

Управление ограничениями

Сертифицированная по FM модель управления ограничениями (1/16 DIN UDC 1000) может использоваться для безопасной отсечки.

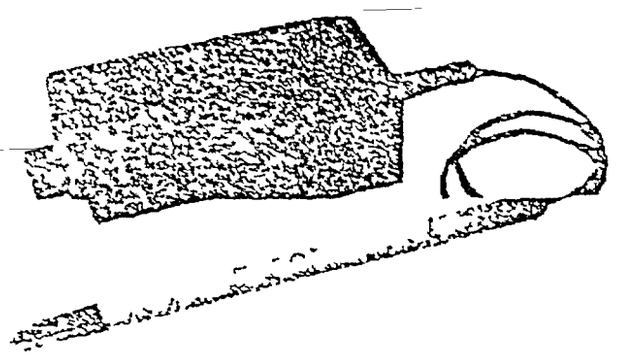
Разносторонее применение

Предварительная настройка, автоматическое переключение, уставка линейно меняющегося сигнала и возможность связи позволяют UDC 1000 и UDC 1500 контролировать температуру, давление и другие параметры в различных устройствах таких как пресс-формы для пластмасс, печи и горны, камеры стерилизаторов, в оборудовании для пищевой промышленности, упаковщиках и холодильниках.

Основные характеристики

- Герметичная передняя панель (NEMA 4 / IP66)
- Двойной 4 разрядный дисплей
- 2 года гарантии
- Универсальные входы
- Универсальные источники питания
- 3 типа выходов: релейный, SSR, DC
- Выходные алгоритмы: пропорциональный времени, токовый, трехпозиционное шаговое управление, нагрев/охлаждение
- Передача параметра процесса и уставки на выход
- Уставка линейно меняющегося сигнала
- Предварительная настройка и самонастройка
- Стабилизация контура
- Защита конфигурации паролем
- Сдвоенная сигнализация
- Связь RS485 ASCII
- Переключение автоматический/ручной режим
- Распознавание верхнего предела
- Сертифицированная по FM модель управления ограничением
- Предстоящая сертификация CSA

BEST AVAILABLE COPY



- Accurate over the Full Range of Humidity
- Temperature Limits of
- Exceptional Durability and Stability

MANUFACTURING PROCESSES ■ DRYERS ■ OVENS ■ ENVIRONMENTAL CHAMBERS

GENERAL DESCRIPTION

The HT255 measures relative humidity with a HYCROMER™ C80 capacitive sensor and temperature [illegible] converted into linearized output signals (DC current or voltage) that can be transmitted over a length of cable to a remote display, recorder, computer or data processing [illegible]

OPERATIONAL ENVIRONMENTS

The HT255 was designed for use in industrial environments where temperature at the probe is normally within the limits of −5 to 320°F. Exposure to high humidity or to [illegible]

Advanced filter technology permits trouble free operation in demanding environments with dust and contaminants.

Uses include manufacturing processes, dryers, ovens or [illegible]

SPECIAL FEATURES

The HT255 features the HYGROMER™ C80 humidity sensor. This highly stable sensor typically permits a calibration interval of 1 to 2 years.

Like all HYCROMER transmitters, the HT255 has the unique ability to remain accurate both during and after exposure of the probe to high humidity. A special calibration results in excellent accuracy also at low humidity. Electronic temperature compensation of the humidity sensor maintains accuracy at all temperatures.

Test points permit field calibration of the HT255 without interrupting the output signals.

CALIBRATION

Prior to shipment, each HT255 transmitter is factory calibrated with calibration one. Use of NIST published, traceable data provides traceability. Single point calibrators are available for verifying performance and making adjustments as required.

STANDARD CONFIGURATIONS

The HT255 is available either with a remote probe separated by 6 ft. of cable or with an integral probe. Both probes are designed for through wall installation. A slotted cap is the standard sensor protection.

The standard measuring range is 0–100%RH for humidity and 0–300°F (or −50–150°C) for temperature. Transmitters can be ordered for operation with 115 VAC, 24 VAC or 10–35 VDC. Standard wiring is by cable grips and [illegible]

OPTIONS & ACCESSORIES

Probes can be supplied with a foam filter instead of the standard slotted cap. This is required in applications that involve dust, spray and/or air velocity above 500 feet/min. Special enclosures are available with 1/2" conduit adapters or a connector. A probe holder with mounting flange can be ordered to simplify installation of the probe.

Field calibration can be done with either a calibration device or a one point calibrator, both available from PIC. The calibration device is a small chamber that fits tightly [illegible] verification at several specific humidity values. The one point calibrator is a portable instrument that provides a reference measurement. This is used to adjust the transmitter outputs at one set of conditions.

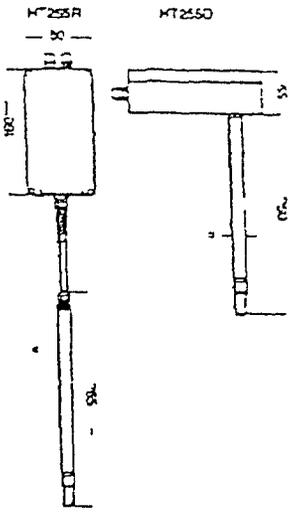
HUMIDITY KNOWLEDGE THAT WORKS

SPECIFICATIONS

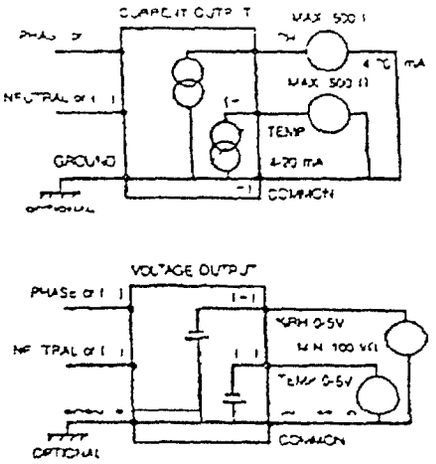
Transmitter Model	HT255D with Probe HT255R with Remote Probe
Humidity Sensor	ROTRONIC HYGROMER® Cap
Temperature Sensor	Pt 100 RTD
Standard Circuit Range Humidity	0 100 %RH
Temperature	0 50°C (32 122°F) Optional Range
Accuracy Humidity	± 1 %RH (1) from 10 100 %RH at 20 (25°C) ± 2%RH (2) from 0 100 %RH at 20 (25 C)
Temperature	± 1 0 F (± 0 5 C)
Hysteresis (4 Hour Cycle 20 95 20 %RH	0 3 %RH Max
Repeatability	0 6 %RH or better
Typical Long Term Stability	0 5 %RH or better over one year
Sensors Time Constant	10 seconds or better
Temperature Limits at Electronics	20 to122 F (-5 to 50 C)
Normal Temperature Limits at Probe	- 5 to 320°F (-20 to 160 C
Maximum Humidity at Probe	100 %RH up to 185°F (85 C) 90 %RH at 212 F (100°C) 60 %RH at 265 F (130°C) 30 %RH at 320 F (160 C)
Electrical Connections	AC Supply Voltage 5 Wires + Ground DC Supply Voltage 4 Wires and Ground
Wiring Type	Terminals 12 AWG Max 2 Cable Glands (Standard)
Power Requirements	115VAC or 24VAC 2 5VA or 10 35 DC 60mA
Output Signals (Linear)	2 x 4 20mA Max Load 500 Ohms 2 x 0 5 V Min Load 100 kOhms
Minimum DC Voltage for 4 20 mA Outputs	5VDC + 0 02 x Load Min 10 VDC
Calibration Adjustment	35 80 10-0 %RH Potentiometers T min & T max Potentiometers
Calibration Device (Order Separately)	ER15
Humidity Standards (Order Separately)	EA00-05 1 0-20-35 50-65 80 95 %RH
Probe Dimensions [3]	250 x 15mm (10 x 0 59)
Probe Material	Fluorocarbon
Probe Cable Length (Remote Probe)	2 ft Standard (10 ft Max)
Sensor Protection	Slotted Cap Standard) MF15 Dust Filter (Optional)
Dimensions of Case	160mm (H) x 80mm (W) x 55mm (D) 6 3 8 x 3 1 8 x 2 1/4
Case Material	Polycarbonate
Case Protection	NEMA 4 IP 65
Probe Holder (Order Separately	CMA 5

(1) Calibrated using certified traceable instruments
(2) Standard factory calibration
(3) For accurate results immerse at least 8 12 of the probe in the environment to be measured

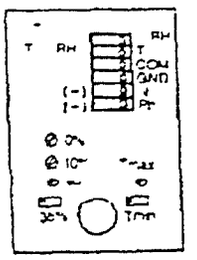
OUTLINE



WIRING DIAGRAM



WIRING CONNECTIONS AND CALIBRATION POT



HOW TO SPECIFY: When ordering, please specify the following: Output signals temperature range sensor protection (slotted cap, filter) type of probe holder

BEST AVAILABLE COPY

[illegible]	[illegible]
[illegible]	от 0 °C до 55 °C
[illegible] влажность	от 20 до 95%
Вход параметров процесса	По выбору • термопары R S J T K L B • термометров сопротивления PT100 [illegible] 0-10 В 2-10 В
[illegible] выборки	[illegible] раза за секунду
[illegible] управления	Токовый [illegible] Релейное [illegible] • электромеханическим реле (2 А/240 В) • [illegible] (>4 А В для 250 [illegible]) • трех позиционным шаговым управлением • временно и токовый пропорциональный [illegible]
[illegible]	Конфигурируется [illegible] • Вкл./Выкл. [illegible] • ПИД • ПД – ручной сброс
Сигнализация	До 2 реле (2А/240В) основанных на • сигнализации нижнего или верхнего предела параметра [illegible] • сигнализации рассогласования верхнего и нижнего значения • сигнализации отключения от диапазона • сигнализации на логической комбинации "И" или "ИЛИ" • сигнализации по контуру
[illegible]	от 90 до 264 В переменный ток 50/60 Гц от 24 до 40 В переменный или постоянный ток [illegible]

Габариты изделия LDC 1000

Лицевая панель	48 x 48 мм
Глубина	110 мм
Монтажное отверстие в панели	[illegible]

Габариты изделия UDC 1500

Лицевая панель	48 x 96 мм
Глубина	100 мм
Монтажное отверстие в панели	45 x 92 мм

LEADERLINE - лучшие эксплуатационные характеристики, лучшие цены

Приборы серии LeaderLine разработаны с таким расчетом, чтобы обеспечить Вас самыми лучшими эксплуатационными характеристиками при минимальных капиталовложениях. Каждое из устройств серии LeaderLine в своем классе характеризуется лучшим по сравнению с изделиями конкурентами качеством, подкрепленным последовательной гарантией и программой технической помощи пользователей, являющейся беспрецедентной. Приборы серии LeaderLine имеют функциональные возможности, направленные на решение конкретных задач, и Вы таким образом покупаете

Honeywell

[illegible] - Стерх Промышленная Автоматизация *Мы Помогаем Вам Управлять Окружающим Вас Миром*
[illegible]ванская 27
[illegible] Москва/Россия

в Москве	(095) 415-2976
[illegible]ковый тел	7-502-224-1173
[illegible]ковый факс	7-502-224-1463

BEST AVAILABLE COPY

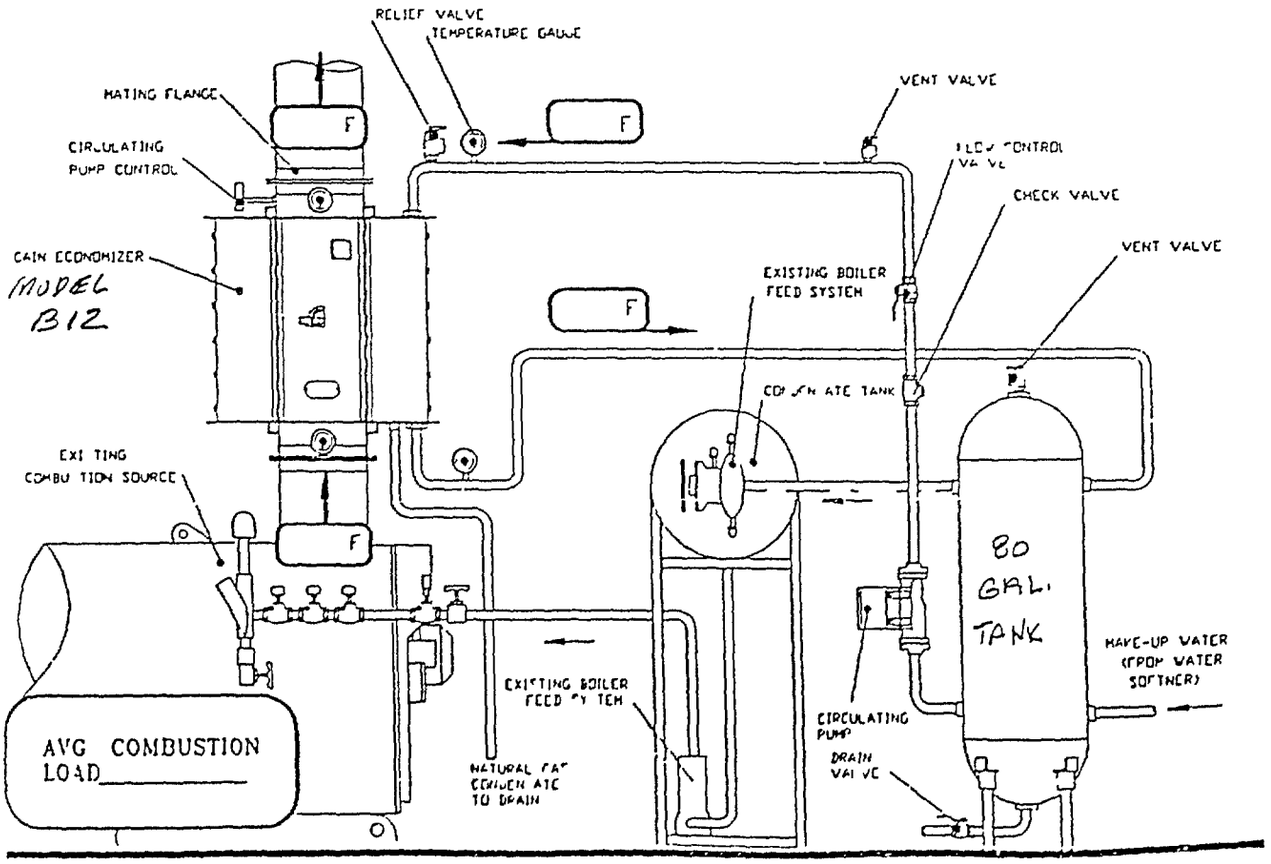
BEST AVAILABLE COPY

FLOW DIAGRAM

CIRCULATING FLOW DIAGRAM

Bul #21749

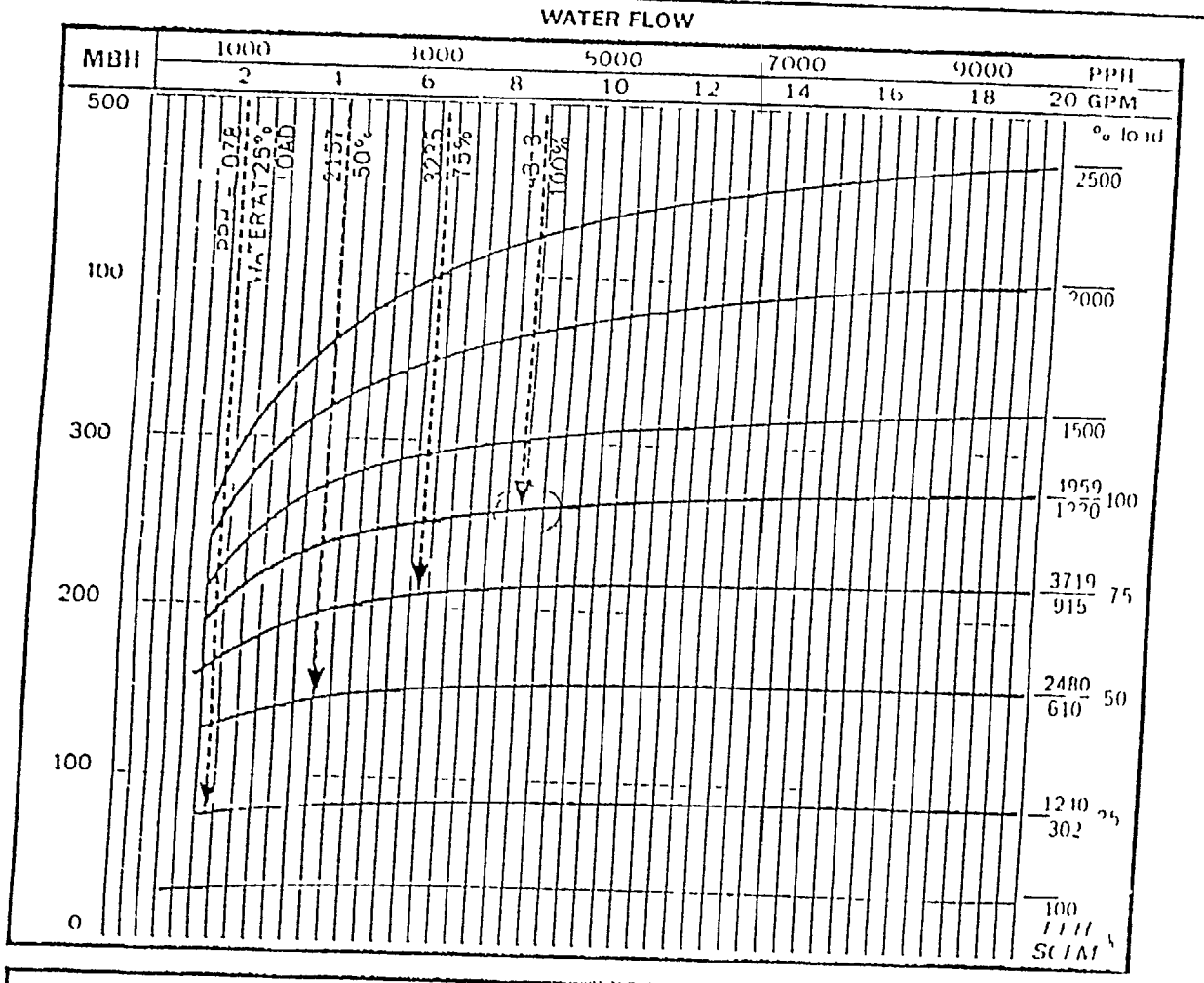
HEATING BOILER MAKE-UP WATER



Recommended BHP 125	Model B12 6 FINS/INCH CIRCULATING OR PERFORMANCE CURVES PREHEATING BOILER FEED

CAIN INDUSTRIES
FUEL SAVING ECONOMIZERS

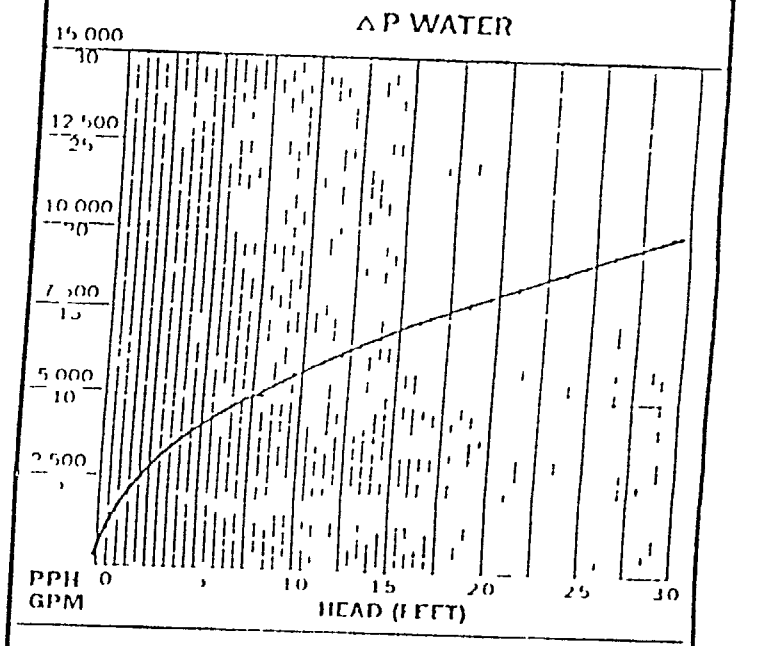
BULLETIN NO. 224

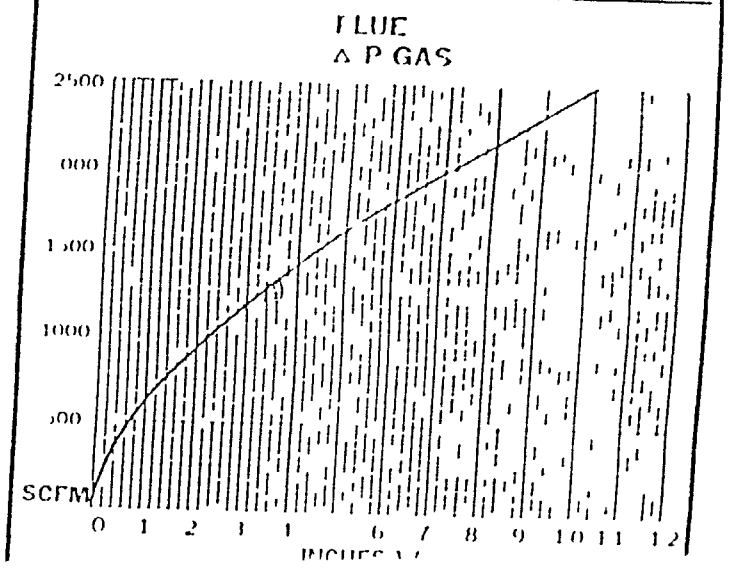


Correction Factors	(MBH x Multiply by	29	60	90	1 0	1 17	1 55	1 83
	F T D 1	100	200	300	310	400	500	600
	Multiply by	78	85	95	1 0	1 05	1 14	1 21
	(Gas Side Pressure Drop x							

TGO = Temp Gas Out = TGI + ((BTU/HR ÷ SCFM) ÷ 1 0845)
TLO = Temp Water Out = TLI + (BTU/HR ÷ PPH Water)

HEATING SURFACE 218 FT² TUBE SA 210 TP 316 ALUMINUM FIN



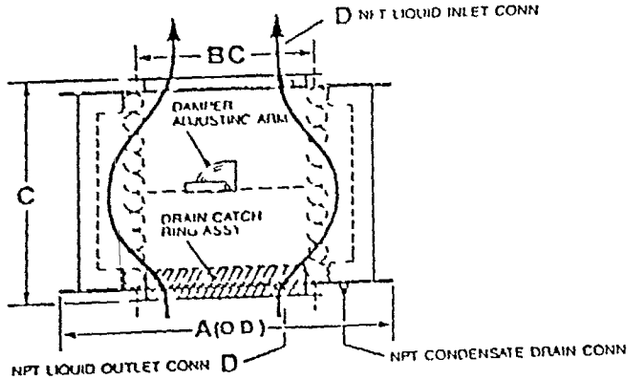


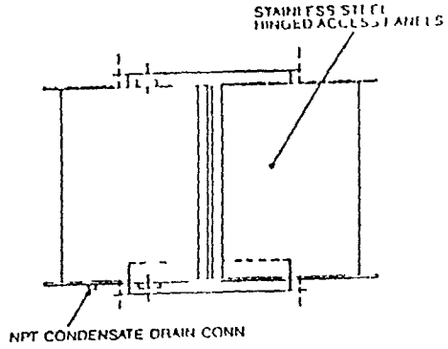
BEST AVAILABLE COPY

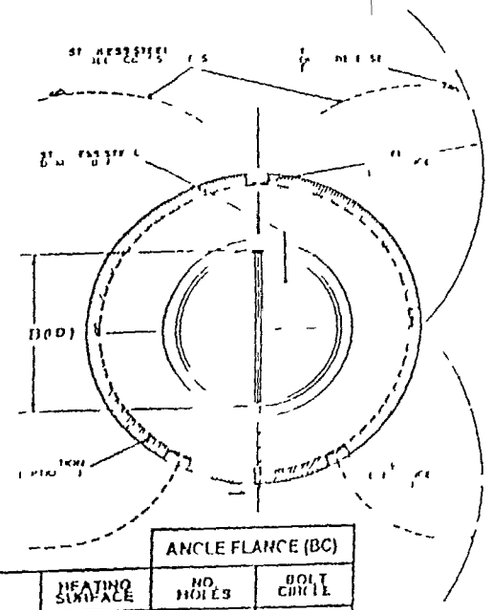
GAS	6	100	4313	220	261	2 15	4959	465	323	24	190 779	239 973	218	275	36	345
		75	3235	220	265	1 46	3719	460	315	13	146 720	184 553				
		50	2157	220	265	70	2480	445	301	06	97 180	123 012				
		25	1078	220	264	20	1240	420	280	01	46 989	61 024				
NO 2		100	4313	220	264	2 45	5154	465	323	24	191 122	230 267				
		75	3235	220	266	1 46	3866	460	315	13	145 020	175 782				
		50	2157	220	265	70	2578	445	301	06	97 897	119 386				
		25	1078	220	267	20	1288	420	282	01	50 499	63 123				
GAS	4	100	4313	220	253	2 45	4959	465	359	16	112 259	179 842	151	275	36	330
		75	3235	220	254	1 46	3719	460	351	09	110 566	139 076				
		50	2157	220	254	70	2480	445	334	04	74 345	94 108				
		25	1078	220	254	20	1240	420	310	01	36 928	47 958				
NO 2		100	4313	220	253	2 45	5154	465	360	16	142 510	171 699				
		75	3235	220	251	1 16	3866	460	351	09	111 176	134 759				
		50	2157	220	255	70	2578	445	335	04	74 880	91 317				
		25	1078	220	257	20	1288	420	313	01	39 599	49 498				
NO 6		100	4313	220	253	2 45	5145	465	360	16	142 009	170 070				
		75	3235	220	254	1 46	3859	460	351	09	110 041	132 579				
		50	2157	220	251	70	2573	445	335	01	71 167	89 899				
		25	1078	220	251	20	1286	420	310	01	36 837	45 760				

ECONOMIZER MODEL NO B12

DIMENSIONAL LAYOUT







WEIGHTS AND DIMENSIONS (INCHES)

DRY WT LBS	A	B	C	D	HEATING SURFACE	ANGLE FLANGE (BC) NO HOLES	ANGLE FLANGE (BC) BOLT CIRCLE
260	36	16	275	1	218	8	18

BEST AVAILABLE COPY

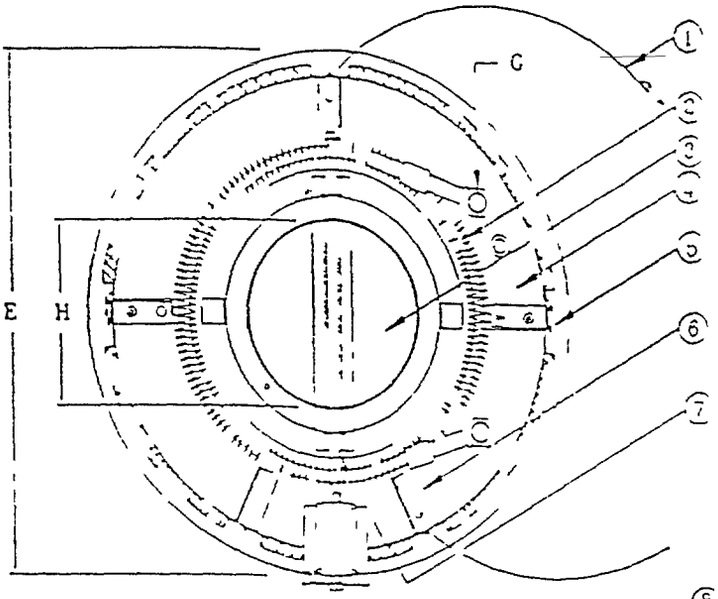
SUBMITTAL

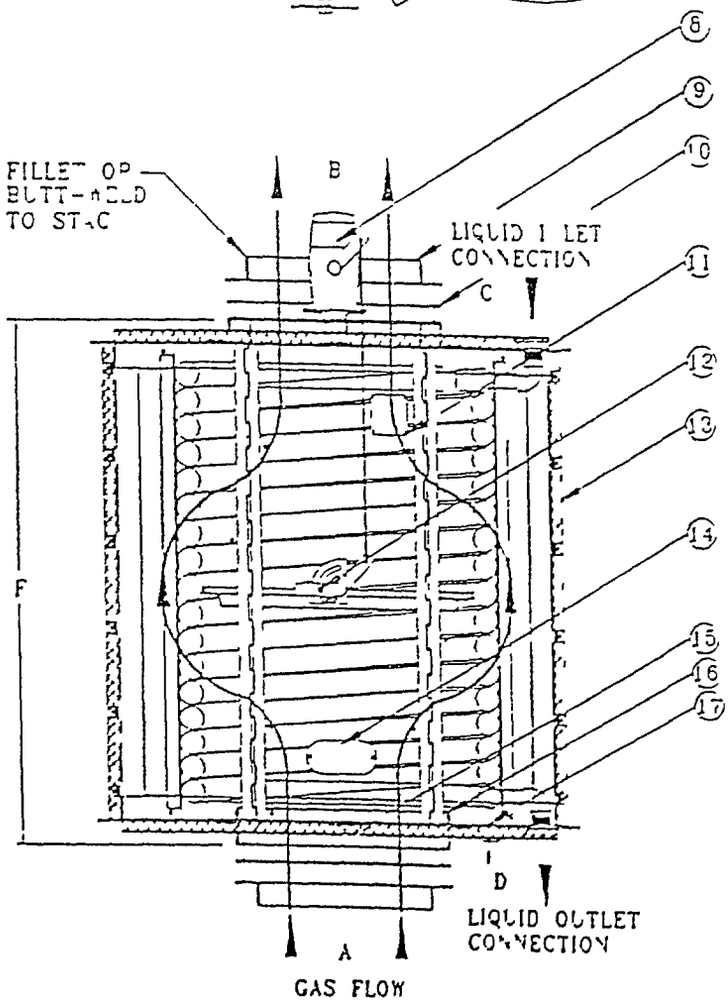
DATE _____ PET _____ FOR _____
B- _____ C O _____

B-SERIES

PERFORMANCE
AND
DIMENSION DATA

A	F
B	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	OAD
[illegible]	OAH
G	NPT
[illegible]	D
	WGT
	LS
	PSIG
	TEMP





PARTS LIST

(SEE DESIGN DATA FOR CONSTRUCTION)

1 HINGED STAINLESS ACCESS PANEL
2 FIRE-TUBE ASSEMBLY
3 STAINLESS FLUE GAS BYPASS
4 LID ASSEMBLY
5 SELF-LOCKING TENSION LATCH
6 SUPPORT BRACE ASSEMBLY
7 DAMPER SHAFT
8 MODULATING DAMPER ACTUATOR (OPTIONAL)
9 WATER FLANGE (OPTIONAL) (SEE WETTING FLANGE LIST FOR DIMENSIONS)
10 GASKET (OPTIONAL)
11 ASME STAMP (OPTIONAL)
12 MANUAL BYPASS ADJUSTING ASSY
13 INSULATION (OPTIONAL)
14 CAIN INDUSTRIES LOGO
15 LIFTING LUG
16 DRAIN CATCH RING (OPTIONAL)
17 1 NPT CONDENSATE DRAIN

Cain Industries Inc PO Box 189 Germantown WI 53022 414-251 0051 WATS1 800 558 8690 FAX1 414 251 0118

BEST AVAILABLE COPY

85

BEST AVAILABLE COPY

SUBMITTAL

PUMP KIT ASSEMBLY

BUL #10010

PUMP KIT ASSEMBLY

	P/N	NPT	A	B	C	D	E	F
✓	99 30	1	5 1	6	18	5 08	55 54	55909
	9 640	1 1	5 0	5	5 040	484	55154	55909
	99 50	2	5 40	5 9	55 1	55340	55154	5 909
	9 3		3	4 3	5 4 1	40	1	309
	99	1 1/	9		5104	5 3	551	5 9 9

A CIRCULATING PUMP

SEE BUL #10020 FOR PERFORMANCE GRAPHS

	P/N	WGT	H P	VOLTS	AMPS
	5021	12	1/12	115	1 85
✓	55 30	15	1/6	115	15
	40	44	1/1 1/4 OR 1/	1	4 6
	5 50	49	3 /2 OR 3/4	11	8 5
	5 99	4	1/	11	4 5

B OR TEMP (MAX NET HP)

B FLOW CONTROL VALVE Brass

	P/N	NPT
✓	15	3/4
	55316	1
	55307	1 1/
	55309	2

C CHECK VALVE Brass

	P/N	NPT
✓	316	3/4
	55316	1
	51040	1 1/
	5421	2

D RELIEF VALVE, Bronze

	P/N	INLET	OUTLET	PSIG
	308	3/4	3/4	125
	5 332	1	1	125
✓	55484	3/4	1	12
	5 340	1	1	1 0
	348	1	1	200

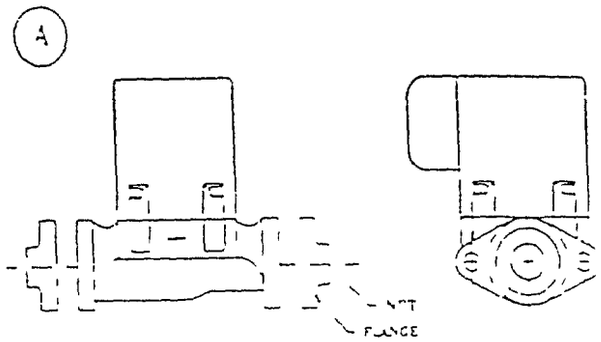
TEMPERATURE 210F @ 125 PSIG

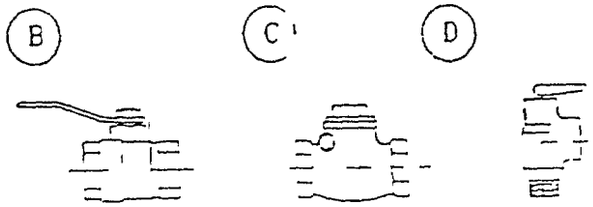
E PUMP CONTROLLER

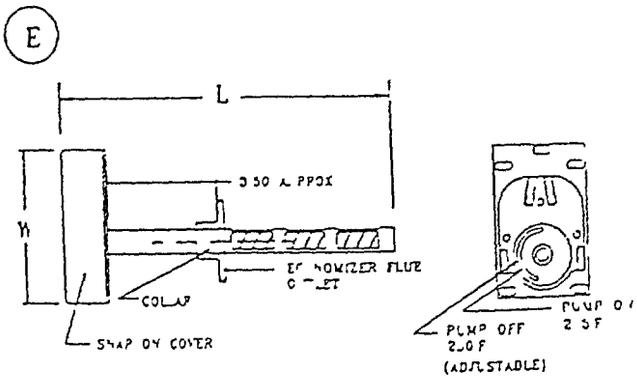
	P/N	L	W
✓	55154	13 25	4 2

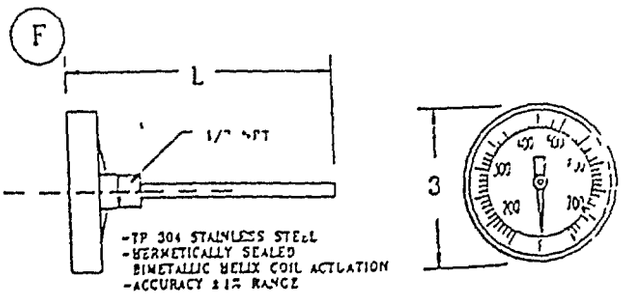
F (2) THERMOMETERS, Gas F

	P/N	L	TEMP F
✓	55903	5 5	200
	5 662	12	1000
	55865	12	1200









Cain Industries, Inc P O Box 189 Germantown, WI 53022 414-251 0051 WATS1 800 552 3690 FAX1-414 251 0118

SUBMITTAL

VERTICAL PRESSURIZED STORAGE TANK

Bul #21800

SELECT TANK SIZE BASED ON ECONOMIZER BTU, HR RECOVERY

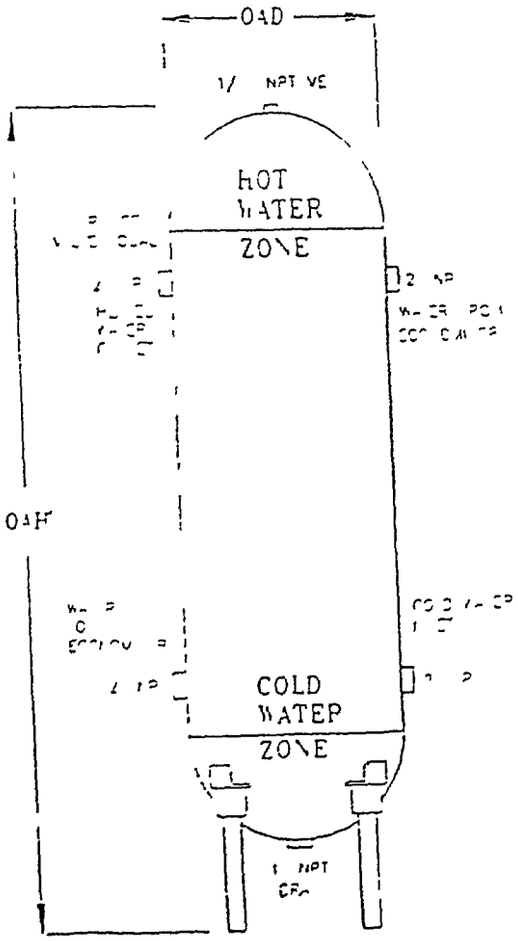
[illegible]	MODEL # TANK	CAPACITY GALLONS	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	15	1		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
100,000	14-2	40	14	6	[illegible]
150,000	16-1	60	16	7	[illegible]
200,000	20-1	[illegible]	20	[illegible]	
250,000	22-2	[illegible]			
[illegible]	24-[illegible]	[illegible]	[illegible]		
350,000	24-2	140	24		
400,000	30-1	190	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]			
8[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]		
	[illegible]	4			
	[illegible]	4			
	[illegible]				
	[illegible]	[illegible]	4		

DESCRIPTION

THE VERTICAL PRESSURIZED STORAGE TANK IS APPLIED IN SYSTEMS WHERE SENSIBLE WATER FLOW THROUGH THE ECONOMIZER CAN NOT BE CONSTANT OR SOMETIMES DROPS DOWN TO AN UNACCEPTABLE FLOW RATE. THE APPLICATION OF THE SEPARATE STORAGE TANK ALLOWS ABSOLUTE CONTROL OF ECONOMIZER OUTLET FLUE GAS AND WATER TEMPERATURES WHICH CAN BE MAINTAINED IN ADDITION TO THE MAXIMUM BTU/HR RECOVERY. MAXIMUM BTU/HR RECOVERY IS ALWAYS POSSIBLE BECAUSE WATER IS CIRCULATED FROM THE BOTTOM OF THE TANK OR COLD WATER ZONE (WHERE NEW WATER ENTERS) TO THE ECONOMIZER AND BACK TO THE TOP OF THE TANK OR HOT WATER ZONE (WHERE HEATED WATER LEAVES). THIS ALLOWS THE GREATEST ENTERING TEMPERATURE DIFFERENCE TO OCCUR FOR MAXIMUM HEAT TRANSFER EFFECTIVENESS AT ALL TIMES. THE TANK BECOMES THE NEW HEAT SINK OR BULGE IN THE WATER FLOW LINE AND IS SPECIFICALLY USED FOR

1. PROCESS WATER CONTROL
2. PREHEATING MAKEUP WATER TO THE CONDENSATE TANK OR DEAERATOR
3. PREHEATING BOILER FEEDWATER LEAVING THE BOILER FEED PUMP TO THE BOILER

THE PRESSURIZED TANK SYSTEM WILL ELIMINATE ANY POTENTIAL FLASHING IN THE ECONOMIZER AND FOR ON/OFF BOILER FEEDWATER SYSTEMS AVOIDS MAJOR FEEDWATER PIPING AND CONTROL CHANGES. THE EXISTING WATER FLOW SYSTEM WILL NOT BE AFFECTED EXCEPT FOR THE CONTROLLED INCREASE IN WATER TEMPERATURE AS A RESULT OF THE BTU RECOVERED FROM THE WASTE HEAT COMBUSTION SOURCE



NOTES

1. MANUFACTURED IN ACCORDANCE WITH SECTION VIII ASME PRESSURE VESSEL CODE
2. LEGS ARE FURNISHED WITH ALL TANKS
3. MATERIALS OF CONSTRUCTION BLACK STEEL
4. RELIEF VALVE INSTALLED IN TEE AT HEATED WATER OUTLET CONNECTION UPON INSTALLATION
5. DESIGN PRESSURE 200 PSIG

Cain Industries, Inc P O Box 189 Germantown, WI 53022 414-251-0051 WATS1 800 558 8690 FAX1 414 251 0118

BEST AVAILABLE COPY

APPENDIX B RESULTS OF TESTS BY MEANS OF ENERAC-2000 GAS ANALYZER

88

Results of boiler exhaust tests on n Boiler No 1fwith o 9 t/hr
Boiler size 1 6 to 0 9 tonne/hour

TIME 14 23 58

DATE 11/27/97

FUEL NATURAL GAS 21870 BTU/LB

COMBUSTION EFFICIENCY	84 4	%
AMBIENT TEMPERATURE	24	°C
STACK TEMPERATURE	150	°C
OXYGEN	04 2	%
CARBON MONOXIDE	0	MGM
CARBON DIOXIDE	09 4	%
COMBUSTIBLE GASES	0 00	%
STACK DRAFT (INCHES H20)	-0 3	
EXCESS AIR	22	%
NITROGEN OXIDES	62	MGM
SULPHUR DIOXIDE	0	MGM
CARBON MONOXIDE ALARM	200	PPM

MODE MGM OXY_REF=0%

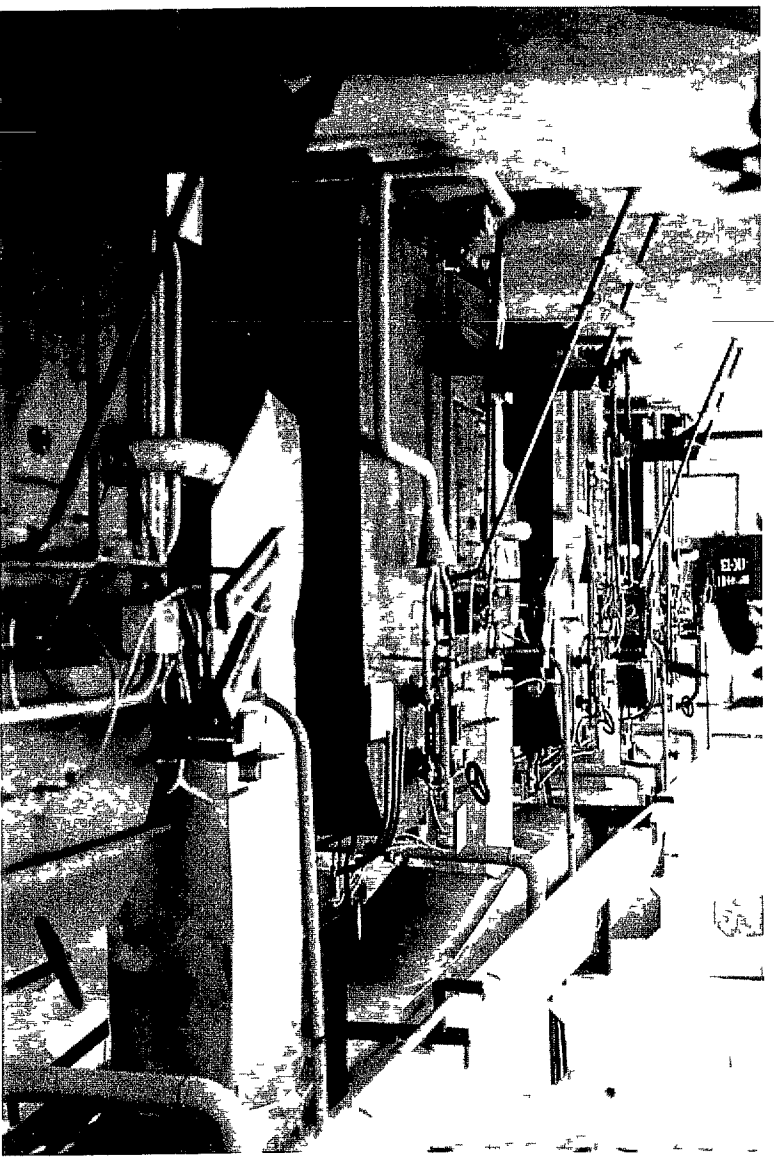
APPENDIX C PHOTOGRAPHS OF THE ENTERPRISE

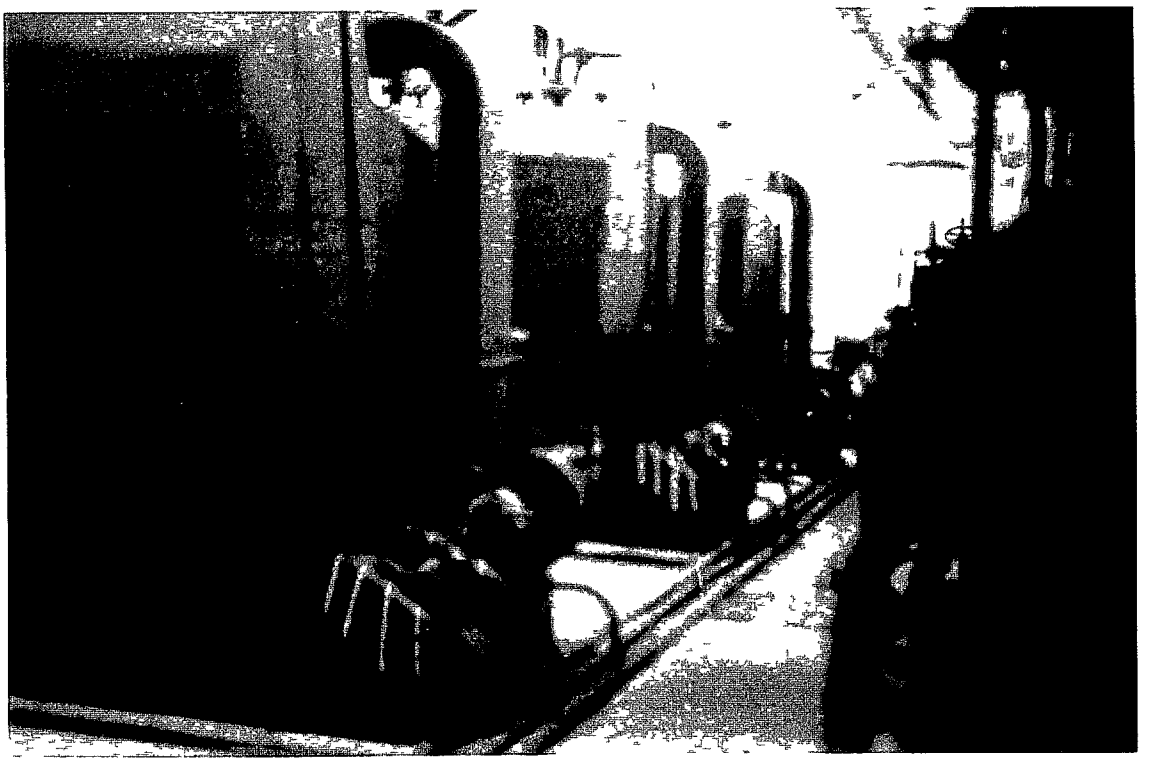
Котельная хлебозавода

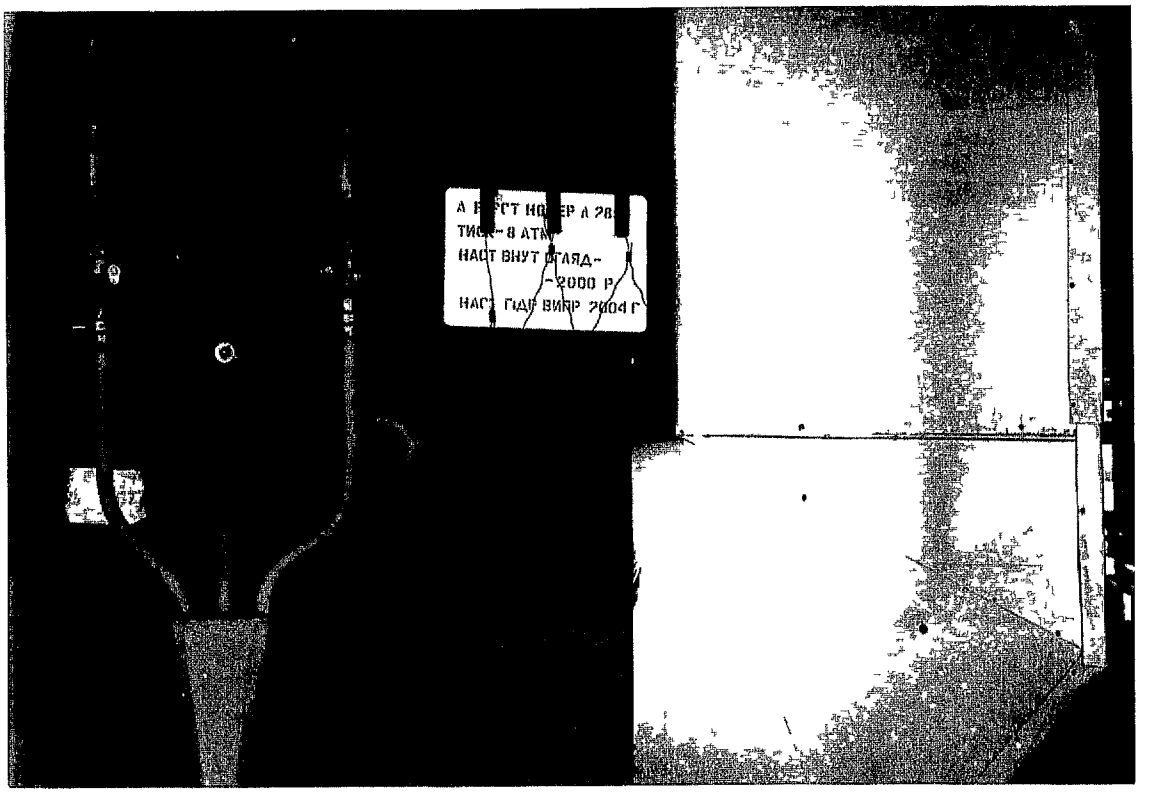
Котлы Е-1,6-0,9

Bakery's boilerhouse

E-1,6-0,9 boilers

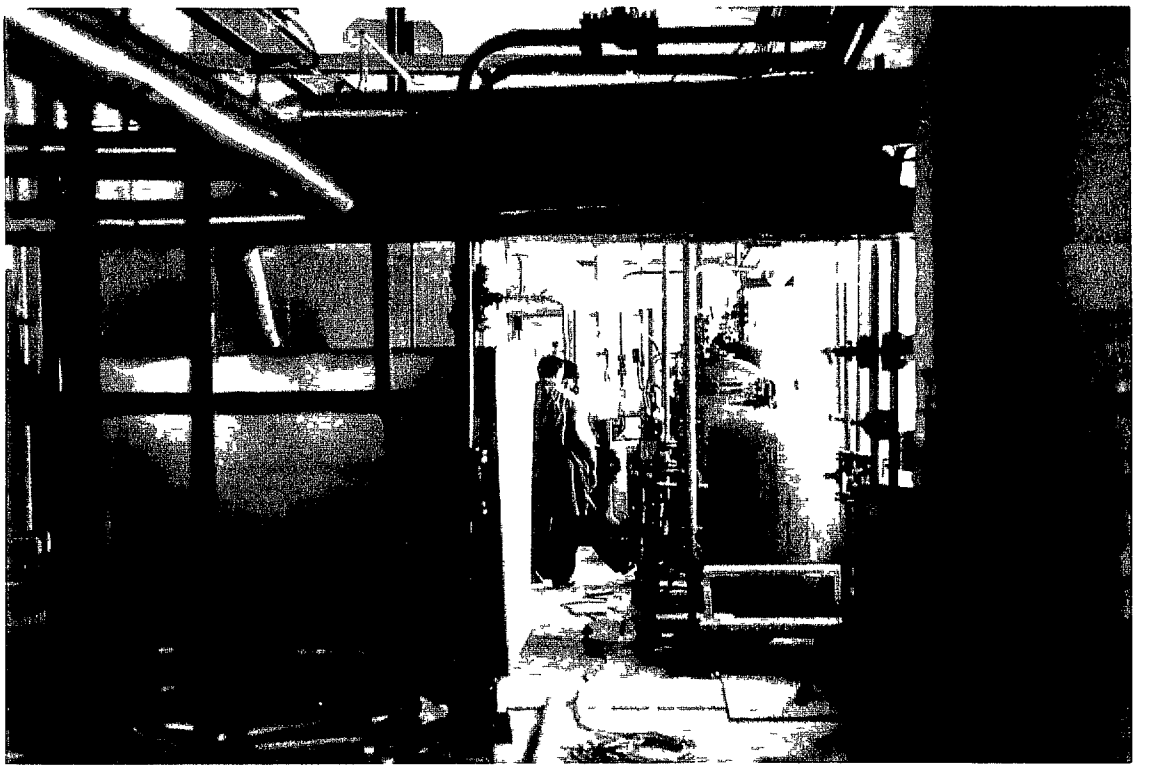






Воздуховод уходящих из котла Е-1,6-0,9 газов

E-1,6-0,9 Boiler's exhaust gas duct

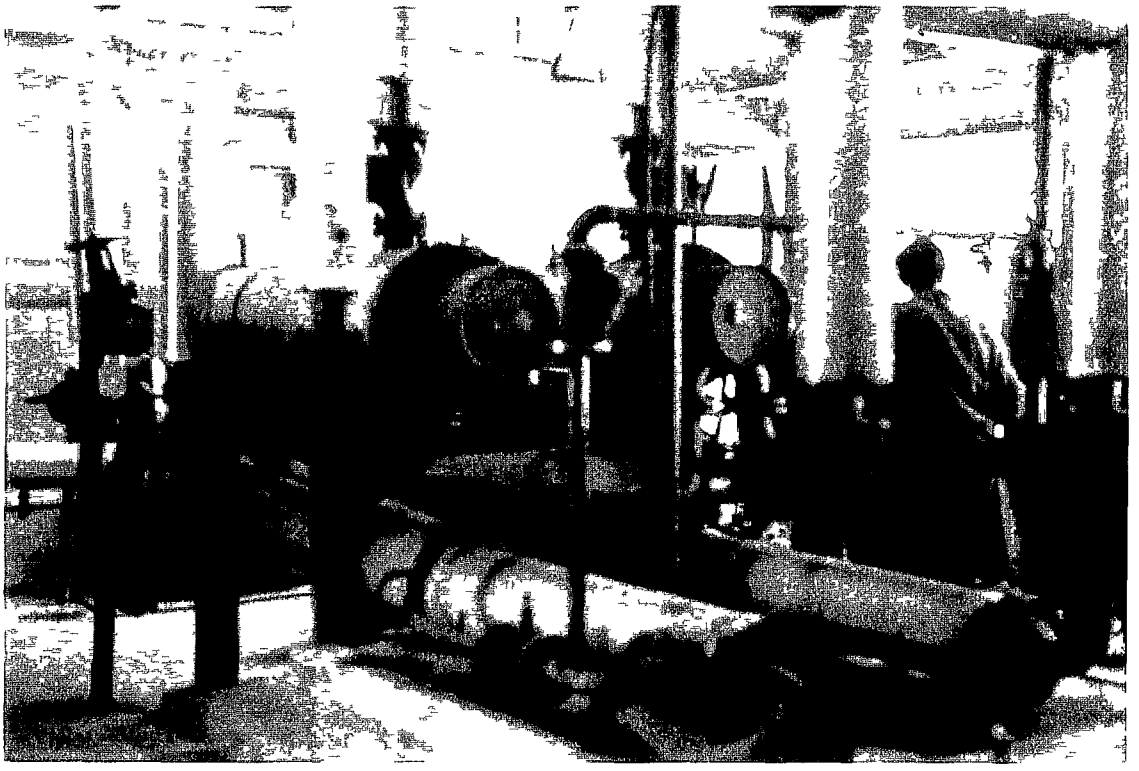


Fans in the boiler house

Дутьевые вентиляторы в котельной

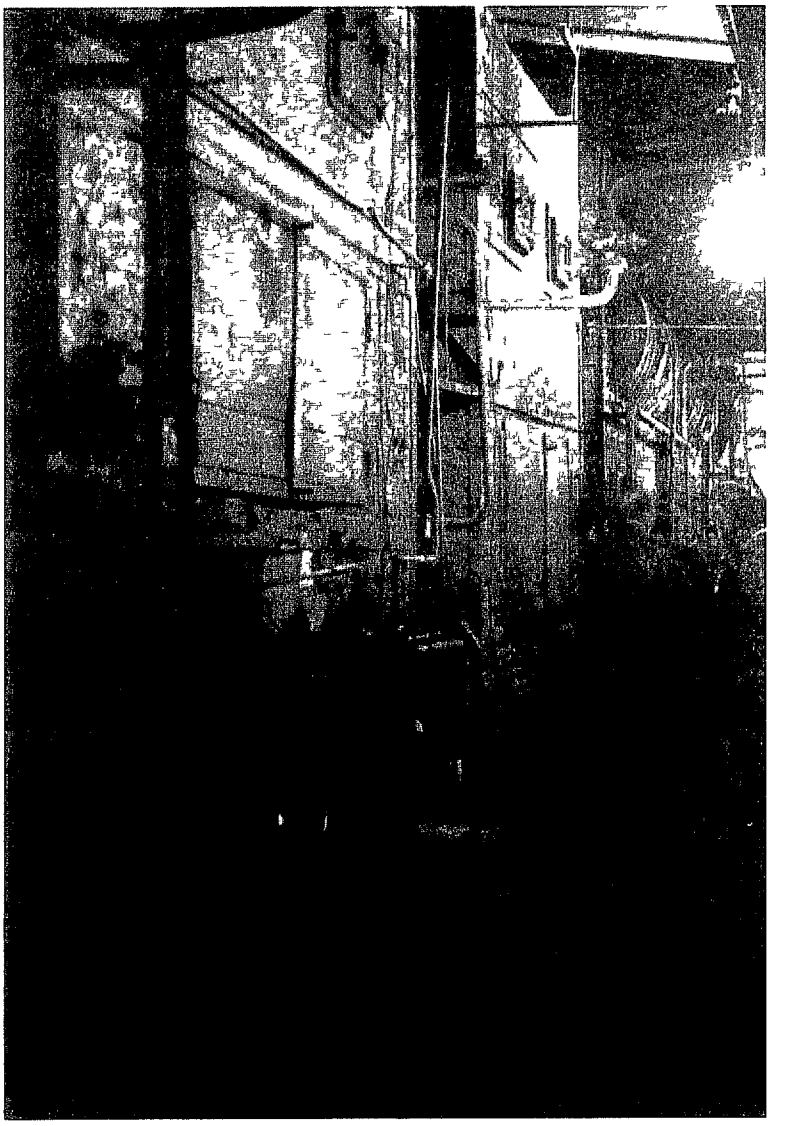
Одинарное остекление заводских цехов и водяные радиаторы

Single glazing of bakery's shops and water radiators



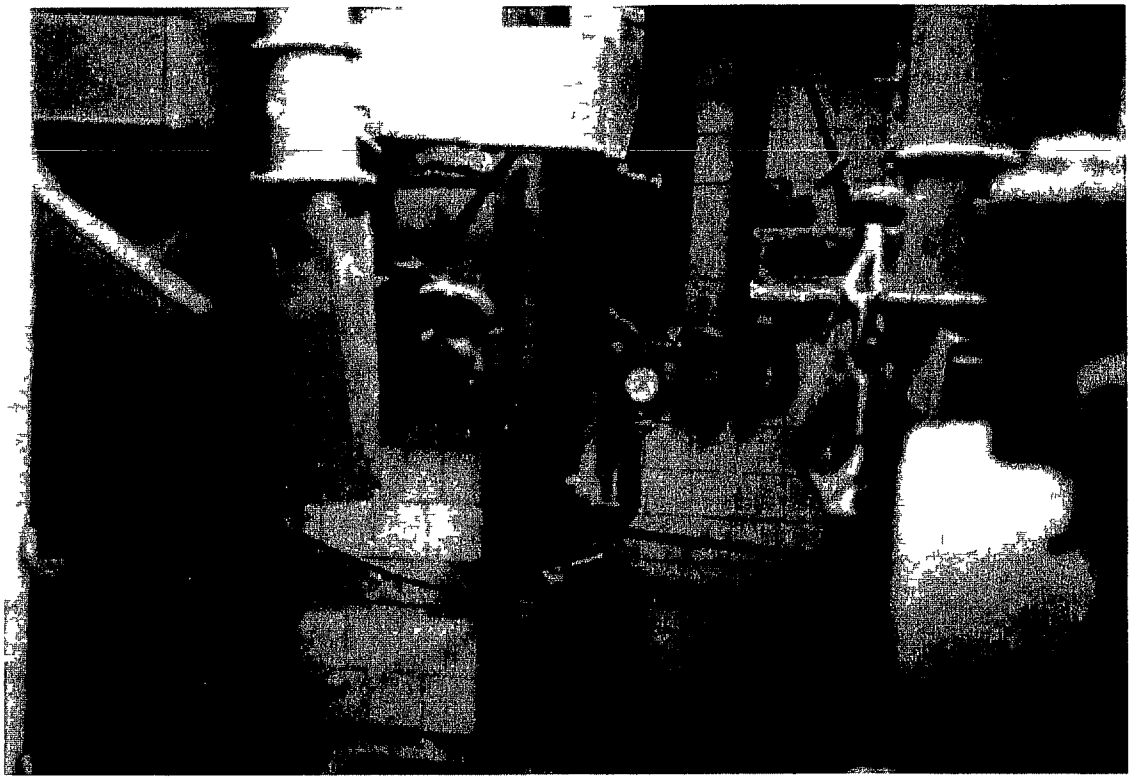
Water heaters in the boiler house

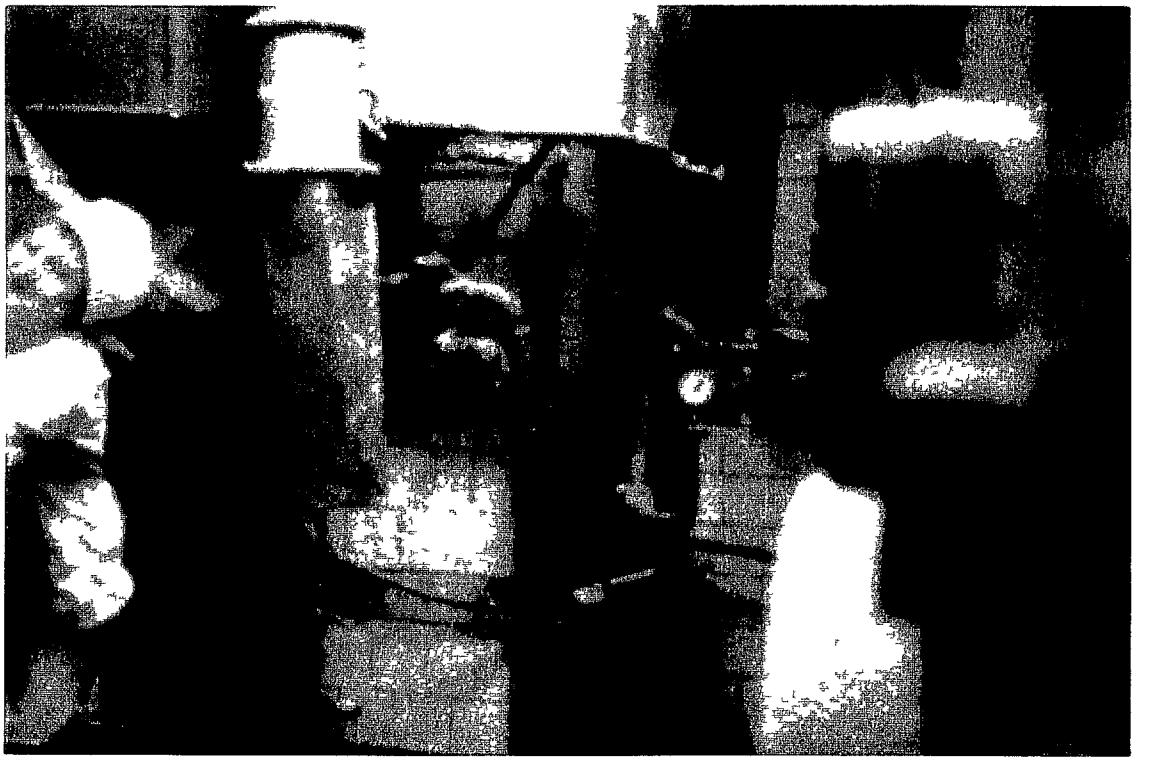
Водоподогреватели в котельной



Газовые печи ФТЛ-2
хлебного цеха

FTL-2 gas ovens
of the bread shop





Пароподводы к газовым печам ФТЛ-2 хлебного цеха

Steam supply lines to FTL-2 gas ovens of the bread shop

APPENDIX D CONVERSION FACTORS

96

CURRENCY EQUIVALENTS

1 hrn - a Ukrainian money unit
1 hrn = 0,5 x US $1 (the state on April 1998)

CONVERSION FACTORS

HEAT

1 cal = 4 187 J
1 kcal = 4 187 kJ = 3 968 Btu
1 Gcal = 4 187 10^3 MJ = 4 187 GCal
1 Btu = 1,055 J = 1 055 kJ = 1 055 10^{-3} MJ

POWER

1 W = 3 6 10^3 J = 3 6 kJ
1 kW = 3 6 10^3 kJ = 3 6 MJ = 860 kCal
1 MW = 3 6 10^3 MJ = 0 86 GCal
1 kcal = 1 163 10^{-3} kW
1 Gcal = 1163 kW = 1 163 MW
1 kW = 1 36 HP
1 kW = 1 34 hp

PRESSURE

1 kgf/cm^2 = 1 barg
1 barg = 101 325 kPa = 0 1 MPa
1 bar = 10^5 Pa = 100 kPa = 0 1 MPa

LENGTH UNITS

1 mm = 0 0394 in = 0 00328 ft
1 cm = 0 3937 in = 0 0328 ft
1 m = 39 37 in = 3 281 ft

WEIGHT UNITS

1 g = 2 2046 10^{-3} lb
1 kg = 2 2046 lb
1 t = 1000 kg = 2 2046 10^3 lb

AREA UNITS

1 cm^2 = 0 155 in^2 = 1 076 10^{-3} ft^2
1 m^2 = 1 55 10^3 in^2 = 10 76 ft^2

VOLUME UNITS

1 m^3 = 35 31 ft^3 = 1000 l
1 l = 35 31 10^{-3} ft^3
1 l = 0 264 gal (US)

HEAT CONTENT

1 kJ/kg = 0 43 Btu/lb
1 kJ/m^3 = 26 84 10^{-3} Btu/ft^3
1 MJ/m^3 = 26 84 Btu/ft^3
1 kcal/m^3 = 4 187 kJ/m^3 = 0 112 Btu/ft^3

TEMPERATURE

°C = 0 56 (°F – 32)

APPENDIX E ABBREVIATIONS

ABBREVIATIONS

ESCO	- energy servicing company
ECO	- energy conservation opportunity,
Fig	- figure,
hrn	- hryvnia,
tel	- telephone,
USAID	- United States Agency for International Development,
VAT	- value-added tax,

barg - atmosphere gauge
BTU - British thermal unit
°C - degrees CelciuS
cm^2 - centimeter squares
°F - degrees Fahrenheit
g - gram
Gcal - gigacalorie
GJ - gigajoule
h - hour
kcal - kilocalorie
kg - kilogram
kgf - kilogram-force
kV - kilovolt
kV-A - kilovolt-amper
kW - kilowatt
kW h - kilowatt hour
Lm - lumen
m - meter
m^2 - meter squared
m^3 - meter cubed
min - minute
MJ - megajoule
mm H2O - millimeters of the water column
MW - megawatt
t - tonne
t/h - tonnes per hour
W - watt