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EAPS ENVIRONMENTAL ACTION PROGRAMME SUPPORT PROJECT

SAMARA BEARING PLANT POLLUTION-PREVENTION ASSESSMENT REPORT

An In-Plant Environmental Assessment for Low-Cost/No-Cost Pollution-Prevention and Abatement Measures

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Submitted by:
Chemonics International Inc.

with the cooperation of:
The Russian Engineering Academy, Volga Department
Samara, Russia

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LIST OF ABBREVIATIONS

cu. m	Cubic meters
EAPS	Environmental Action Programme Support
est.	Estimated value
ha	Hectares
kWh	Kilowatt-hours
ppm	Parts per million
Recom.	Recommendation
ROI	Return on investment
Ru/yr	Rubles per year
TER	Technical effectiveness rating
TLV	Threshold limit value (an average, low-risk level of exposure for 8 hours)

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PREFACE

This report documents the results and recommendations of a pollution-prevention assessment conducted at the Samara Bearing Plant with its cooperation and permission.

The EAPS project is a part of the environmental component of the Samara Regional Investment Initiative, a collaborative effort among the U.S. and Russian governments, regional authorities, and private sector entities. The overall purpose of the initiative is to improve the investment environment and overall business climate for sustainable economic growth in selected regions of Russia.

USAID/Russia selected the EAPS project to carry out the initiative's environmental component, which concentrates on activities to promote identification and implementation of no-cost/low-cost measures to improve environmental and economic performance of Samara enterprises. The emphasis is on demonstrating that enterprises can join sound environmental practices with sound business practices and incur little or no financial burden.

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- Sergey V. Makarov, chair, Industrial Ecology of Chemical Technology, Mendeleev University, Moscow, Russia
- Lubov Y. Kirichenko, general director, Industroyprojekt Institute, Samara, Russia
- Vladimir I. Skriagin, lead engineer, Ecology Protection Department of Samara Bearing Plant, Samara, Russia
- Russian Engineering Academy, Volga Department, Samara, Russia

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EXECUTIVE SUMMARY

This report documents the recommendations of a pollution-prevention assessment at the Samara Bearing Plant's small bearing operation (Shop No. 7). The assessment aimed to provide a rapid evaluation of the pollution problems in this part of the plant, and devised recommendations for no-cost/low-cost pollution-abatement measures to improve environmental performance with economic benefits.

The small bearing-manufacturing shop was selected for the assessment based on the recommendation of Samara plant management. Time and budget constraints have limited this assessment to only a partial identification of environmental issues and analysis of cost-effective recommendations. EAPS consultants discussed pollution-abatement recommendations with senior management in an exit interview. Management and the EAPS consultants reached general agreement on the environmental priorities and recommendations, however the company needs to do further work to refine these recommendations and implement them practically.

This report prioritizes the recommendations in terms of investment requirements (not all recommendations are no-cost) and technical effectiveness (probability of success in abating a pollution problem or in achieving economic benefits). The company should view these recommendations as a starting point for the enterprise to develop an environmental management plan for the part of the plant that has been assessed. The consultant recommends that the enterprise apply the step-by-step methodology for pollution-prevention presented in the EAPS guide, "In-Plant Environmental Assessment Sourcebook: A Guide to Pollution Prevention Planning."

SAMARA BEARING PLANT ASSESSMENT

A. The In-Plant Assessment

The in-plant assessment consisted of the following:

1. *Pre-assessment.* This step involved the collection of general information about the facility's operations, the specific shop area chosen for the assessment, and waste issues. The information collected during this phase was based on a pre-assessment questionnaire (Annex A) EAPS provided at the start of the program, and two meetings with technical experts the plant assigned to be part of the assessment team.

2. *Two-day walk-through of the operations.* In the walk-through, EAPS evaluated specific waste problems and pollution issues. Interviews were conducted with shop operating personnel and management.

3. *Exit interview with the plant technical experts.* This interview entailed a review of preliminary findings and recommendations. Pollution-prevention recommendations were further refined.

4. *Exit interview with senior management.* The assessment team presented its recommendations.

The assessment focused on indoor air-quality issues and wastewater discharges in the shop operation that involves the manufacturing of small bearings. The following discussion addresses only the pollution-prevention opportunities identified there.

The plant experts assigned to the assessment team were Vladimir Skriagin, leading engineer, and Natalia Fedorova, ecologist. Chemonics International and the Russian Engineering Academy's Volga Department assigned Nicholas P. Cheremisinoff, team leader, K&M Engineering; Sergey V. Makarov, technical expert; and Lubov Kirichenko, technical expert.

Additional plant personnel who attend meetings and discussions during the assessment were: Vladimir M. Alayev, deputy head of Workshop No. 1 for technical issues; Vladimir I. Gridnev, deputy head of the metal-working workshop for technical issues; Valentine A. Korchunov, head of the workshop of cooling liquids; Georguiy D. Adirchayev, head of the ventilation bureau; Alexander V. Balandin, deputy chief energy specialist of the plant; Mikhail G. Gorkovitov, deputy head of Heat and Energy Supply Group and head of the Wastewater Treatment Station; Vera V. Streltsova, head of the industrial sanitary laboratory at the central plant laboratory; and Svetlana V. Silantyeva, head of the anti-corrosion laboratory at the central plant laboratory

B. Characteristics of the Operation

B1. General Observations

The Samara Bearing Plant manufactures small and medium bearings used in a variety of applications and markets, including automotive, forged pieces, and consumer goods. The capacity of the plant is 230,000 bearings per year. The entire operation covers a territory of 73 hectares (ha). Typical shop operations at this facility include a foundry, thermal and mechanical assembly shops, galvanic shops, forgery and stamping, wood processing, and a boiler house for plant-process steam supply. The plant has an on-site wastewater-treatment facility that has a nameplate capacity for processing up to 6,000 cu. m per year. However the wastewater-treatment capacity at the time of the assessment was less than 50 percent. A main wet chemistry laboratory supports the wastewater-treatment plant with limited analytical capabilities.

The primary solid and semi-solid wastes and pollution the facility generates are metal shavings, grinding slimes/sludges, spent mineral oils, oily sweepings and wastes, various wood-composition

wastes, and oily slimes. The facility reported that it sends approximately 300 tons per year of these types of wastes to an off-site landfill. Liquid wastes are discharged to a municipal wastewater-treatment facility, with estimated amounts being 900,000 cu. m, which includes domestic, non-production wastes in the amount of 420,000 cu. m, and technological wastes of 480,000 cu. m No liquid wastes are contained in on-site ponds or impoundments.

The in-plant environmental assessment focused on Shop No. 7, which is devoted to manufacturing automotive bearings. This shop produces 83 different types of bearings with aperture sizes ranging from 20 mm to 75 mm in diameter. The shop operations are comprised of a semi-automated turning operation, a thermal treatment stage, a grinding and assembly shop, various auxiliary sites for cooling liquids, galvanic (etching) site, and a cutting tool-sharpening site. The entire operation covers a floorspace of approximately 31,000 sq. m. The shop area contains 944 units of basic processing equipment, including 283 turning machines, 8 thermal treatment stations, and 653 grinding machines. Although the operation is enormous, many parts of the operation were not functioning and it was difficult to assess the degree of productivity.

The grinding and assembly stage of the operation produces rings and an assembly stage packs the bearings. This portion of the shop area occupies 10,520 sq. m. The number of machining stations is 653 units, including flat-grinding machine tools and automatic devices for face grinding, centerless grinding, internal grinding, skirting grinding, circular grinding, superfinish, and assembly and molding. Semi-automatic devices exist for electric-chemical marking, wrapping, packing, and others. This phase of the operation has a manufacturing capacity of 11,800 pieces of bearings per year, but again operations were well below production capabilities.

The most recent manufacturing data provided to the assessment team were based on 1997 production figures. The vital statistics reported were:

- Metal consumed: 8,700 tons
- Electric power consumption: 4029 thousand kWh
- Mineral oils consumed: 210 tons
- Chemicals consumed: 23 tons
- Paper-packing materials consumed: 27 tons
- Greasing-cooling liquids consumed: 15,000 cu. m

The technological process of ring grinding includes the following operations:

- Face grinding
- Grinding outside diameters of outside rings
- Grinding an aperture of internal rings
- Grinding of roller paths of outside and internal rings
- Grinding skirting of internal rings
- Super-finishing roller paths
- Rings quality check, including searing presence check, using etching

Eighty-one microlines service these operations. The greasing/cooling liquid applied to the grinding rings is composed of: soda ash 10 to 14 g/l; sodium nitrite 4 to 6 g/l; and water.

The greasing/cooling liquid supply to machine tools is centralized and has a capacity of 500 cu. m. This material is recycled through the process and treated to remove metal shavings and abrasive dust and mineral oil. This treatment step is accomplished by a massive vacuum-filter

unit housed in a subterranean shop area. The vacuum-filter unit is operated in a semi-continuous mode, and uses a disposable cloth made of long fiber paper (Paratex). Oil removal is periodic (every morning, after idle-time settling, and before start of the system), and is done by collecting the oil in traps. Because of bacterial accumulation in the greasing/cooling liquid, the solution must be replaced every two weeks. This is a significant cost issue for the operation and there are substantial savings associated with extending the life of the solution. The spent solution (about 14,000 cu.m/yr) is discharged to the municipal wastewater-treatment facility. The slime collected by the vacuum filter (about 600 tons/yr, which seems very low) is shipped for further waste processing, although the method of treatment and ultimate method of disposal could not be ascertained.

B2. Walk-Through Observations of the Shop

During the assessment, photography of the operations and equipment was not permitted. The operation is housed in a one and a half story building that is organized into four main shop areas partitioned only by partial dividers. Starting from the south end of the operation, there is a lathe-shop operation that was hardly operating during the assessment, followed by a section of plant devoted to cutting and grinding operations and thermal treatment of the bearings. Next was a surface-polishing shop operation, and finally a quality-control and packaging or finishing operation.

Two priority pollution problems were identified:

1. Indoor air quality
2. Wastewater discharges and water recycling

C. Pollution-Prevention Opportunities

C1. Summary of the Pollution-Prevention and Abatement Measures

Pollution-prevention opportunities EAPS identified for the enterprise are organized into a matrix in Tables 1 and 2. Table 1 prioritizes pollution problems and potential pollution-prevention opportunities for air and water pollution. Column 1 defines the type of pollution. Column 2 defines the environmental health and safety impacts of the pollutant. Column 3 lists potential pollution-abatement measures the assessment team identified. Column 4 defines the environmental health and safety and financial benefits the pollution-abatement measure. Column 5 provides an overall technical effectiveness rating (TER) for the pollution-prevention measure (i.e., a qualitative assessment of how effectively the recommendation will minimize the pollution problem). The TER is based on a high (H), medium (M), or low (L) assessment. Cost estimates for the recommendations are based upon single vendor quotations from either local sources or suppliers identified on the Internet. Specific sources/references and supporting vendor information are provided in Annex B. The opportunity to identify multiple supply sources of recommended equipment for cost optimization was not possible during the assignment. The enterprise will need to explore the availability and cost options accessible to them in the region to reduce some of the investment costs.

By prioritizing the pollution-prevention abatement measures for the specific shop, the matrix presented in Tables 1 and 2 forms the basis of an environmental management plan. Although EAPS did not follow all the steps detailed in the "In-Plant Environmental Assessment Sourcebook: A Guide to Pollution Prevention Planning" because of time and budgetary

restrictions, the present assessment does provide a first step in addressing the environmental issues for the small bearing shop operation. EAPS recommends that the matrix summary in Tables 1 and 2 be followed for other in-plant assessments in other parts of the enterprise. Collectively, these assessments can be used to develop a facility-wide environmental management plan with identification of low-cost/no-cost opportunities.

Summaries of the recommendations along with the environmental, health and safety, and financial benefits are given below.

C2. Indoor Air Quality

The indoor air quality of the shop operation is extremely poor and poses a significant health and safety risk. The existing ventilation system is old and needs major overhauls and repairs. Ductworks in many areas have holes, and the union gaskets at flanges were missing. The design itself is peculiar. There is a ventilation system that is designed as exhaust, servicing about 120 hoods at various machines. The exhaust is emitted directly into the external atmosphere without any filtering. A separate ventilation system services the general workroom area. This consists of 90 percent recirculation of the internal workroom/shop air and about 10 percent intake of unfiltered air. The intake air enters through a centrally located shaft that was originally designed with frame-type air-conditioning filters and is heated by hot water coils. The hot water coils are supplied by the plant's steam-generating plant (boiler plant). The filters had been removed at some undetermined time in the past, presumably because they were clogged, and the steam plant is under-supplying heat to the workshop area to economize on fuel.

The air quality in the workroom poses two serious problems:

1. It is of such poor quality that it poses a significant health risk to hundreds of workers. The primary air discharges are oil mist, fine metal particulate matter from grinding and polishing operations, and cleaning and polishing solvents. The particulate matter are in the respirable range, which means that they pose a threat of respiratory damage. These air pollutants, particularly the oil mist, pose a chronic health risk which threatens the productivity of the workforce.

2. The high degree of oil-mist emissions poses a likely potential fire hazard. Although the lower explosion limit for the oil is relatively high, during the summer months temperatures can exceed 30 degrees Celsius. The combination of high temperatures and a very fine mist of relatively high oil concentration in the air raises a concern for spontaneous combustion to occur.

Major emission sources are polishing station machines, which use an oil-emulsion spray for cooling and polishing purposes on the bearing working surfaces. EAPS recommends local containment opportunities to minimize this major source of discharge. Other options that can greatly reduce the risks of exposure are described in the matrix.

EAPS identified several low-cost/no-cost pollution-prevention opportunities to improve the indoor air quality, as well as longer-term pollution-prevention opportunities. EAPS estimated that the low-cost/no-cost pollution-prevention opportunities could improve air quality by more than 60 percent and could improve worker productivity by as much as 15 percent. The longer-term pollution-prevention opportunities along with the no-cost/low-cost could improve air quality by more than 90 percent and substantially reduce long-term health risks and the potential for fire.

Detailed recommendations are provided in Table 2 and summarized below:

Low-Cost/No-Cost Pollution-Prevention Measures:

1. *Floor-maintenance program.* Cost is approximately $500 in equipment and likely to improve air quality by 5 to 10 percent, as well as lower the risk for fire.

2. *Preventive maintenance program.* There is no investment cost other than personnel time. The program is estimated to be able to improve air quality by as much as 50 percent.

3. *Intermittent exhaust fan system operation.* Estimated costs are less than $1,000 for equipment and are estimated to improve air quality by 10 percent.

4. *An automatic air-lock system.* Estimated equipment costs are about $200 and likely to have about a 30 percent direct savings in energy costs for a local ventilation unit. Direct savings are about $100 per month.

5. *Worker rotational assignments.* No investment is needed and health risks can be dramatically reduced.

Longer-Term/More Costly Pollution-Prevention Measures:

1. *Intake air-filter cartridge replacement.* Estimated costs are about $25,000 for filter replacements. Improvement to air quality is estimated at less than 10 percent.

2. *Polishing station local exhaust operation.* The investment requires further definition and testing by the enterprise. It is recommended that a single filtration unit be purchased for $5,000 and optimized to handle multiple polishing stations. This recommendation is a critical issue because it addresses the major source of air emissions and, if widely implemented, alone could improve air quality between 50 to 70 percent.

3. *Ventilation-system redesign.* This is a long-term solution to the problem and requires a detailed feasibility study. The enterprise will likely have to face this investment within the next 10 years or sooner, and the capital investment is likely to exceed $2.5 million dollars.

C3. Water Pollution and Process Optimization

The water-pollution issues have strong economic incentives. The financial incentives that may be captured are:

- Reduction in the use of make-up chemicals used in the cooling/greasing medium
- Reduction in wastewater-discharge pollution fees associated with the spent cooling/greasing medium
- Purchase of less fresh make-up water for the medium

C4. Financial Incentives

EAPS estimates that the total savings combined are between 500,000 to 700,000 Ru/yr. To capture these economic benefits, several recommendations may have to be implemented in combination. The shop needs to assess the technical feasibility of these recommendations and to optimize the operation and maintenance, and investment costs. The most readily achievable economic incentives of 150,000 to 200,000 Ru/yr can likely be realized with low-cost/no-cost approaches. Large portions of these incentives will require investment in some capital equipment, as described in Table 2.

D. Recommendations

EAPS held a final working session with representatives from the Samara Bearing Plant to establish an implementation plan for the recommendations. The meeting focused on the pollution-prevention recommendations made in Tables 1 and 2. Management agreed to begin implementation of all low-cost/no-cost recommendations with the exception of A2 (preventive maintenance program for improved ventilation). Recommendation A2 is viewed as a longer-term improvement program, and the need for implementation will be a lower priority as the warm weather approaches. During the spring and summer months, the ventilation in the shop area dramatically improves because shop windows are opened, allowing fresh air dilution. However, the bearing plant recognizes that poor ventilation is posing both a chronic health problem to workers and a fire hazard. Therefore, management will implement a ventilation program sometime over the next three months and monitor its performance.

For all other recommendations, the plant is moving forward with recommended actions and is monitoring financial savings and improvements to environmental conditions. It plans to assess the program's performance at regular intervals by having the assessment team leader meet and review the monitoring results. Because several of the pollution-prevention recommendations require air sampling and monitoring, the EAPS consultants will help identify appropriate monitoring equipment. EAPS will make an instrumentation recommendation and address procurement issues within three to four weeks of completing the in-plant assessments. EAPS will make these recommendations to USAID and the bearing plant.

For water-pollution issues, low-cost recommendation W1 will be implemented within the first week of May, and an evaluation of its effectiveness will be ready by the middle of May. Regarding long-term/higher-cost recommendations, the bearing plant's highest interests are in recommendations W2 through W4, because these have the highest probability of substantial direct cost savings. Feasibility studies and pilot experiments within the plant will track the performances of each recommendation to arrive at the most cost-effective wastewater program. As follow-up support to the EAPS project, the local Russian consultant will assist the plant at a half-time level in obtaining more accurate estimates and specifications for the needed equipment, and report to the assessment team leader on any issues that require follow-up assistance.

The plant will conduct implementation and monitoring phases between early May and late August or early September. At least three EAPS follow-on progress reports are anticipated to assess the effectiveness of the program.

Table 1. Priority Definition of Environmental Management Issues

Priority Pollution Problem	Environmental Health and Safety Impacts	Potential Pollution-Abatement Measures	Environmental Health and Safety, Financial Benefits	Technical Effectiveness Rating (Low, Medium or High)
		AIR POLLUTION		
Poor Workroom Air Quality (Indoor Air Quality)	• Workers are exposed to fine mists of oil and ultra-fine metallic particulate. • Long term, chronic health risk factors are extremely high. Workers run the risks of lung diseases including emphysema, black lung type disorders, lung scar tissue, and upper respiratory tract diseases. • Risk factors based on World Health Organization resources recommend dust/oil mist exposures to be limited to 8-hour threshold limit values (TLVs) of less than 50 ppm. Concentrations during peak hours of production are likely to be dozens of ppm, and at sources of discharge even higher.	A1. Floor-maintenance program.	• Work force productivity. Air-quality measures have improved productivity levels by as much as 15 percent in paint shop operations, machine parts, manufacturing plants, and other labor- intensive operations with significant airborne emissions. • Long-term health-liability issues potentially may be a savings. Currently the facility owners contribute up to 5 percent of the plant wages to national health insurance. Lower incidents of respiratory diseases could have a positive economic impact on health-care costs. • Potential investment strategies with Western partners on site management will insist on improved work conditions. World Bank loan programs will insist on improvements to safe work practices and air quality.	L(A1)
	•	A2. Preventive maintenance program.	•	H(A2)
	•	A3. Intermittent exhaust operation.	•	H(A3)
	•	A4. Automatic air-lock system.	•	H(A4)
	•	A5. Rotational worker assignments.	•	M(A5)
	•	A6. Polishing station local exhaust system.	•	H(A6)

Priority Pollution Problem	Environmental Health and Safety Impacts	Potential Pollution-Abatement Measures	Environmental Health and Safety, Financial Benefits	Technical Effectiveness Rating (Low, Medium or High)
	•	A7. Intake air-filter cartridge	•	L(A7)
	•	A8. Ventilation system redesign	•	H(A8)
		WATER POLLUTION		
Shop Water Recycling and Waste Discharge	• Periodic soda cooling-liquid waste discharge to municipal sewage. • Allowable limits of discharges: pH, salts (total), nitrogen (NO^{2}-) exceeded. • Cost inefficiencies due to expensive chemicals used.	W1. Use of sodium hydroxide (NaOH) for correction of cooling liquid composition. W2. Use of urotropine as anti-bactericide agent. W3. Improvement cooling liquid treatment technology. Use of suitable coagulant (as PAA) to increase vacuum-filter efficiency. W4. Use of steam condensate instead of fresh water for cooling liquid preparation. W5. Use of in-line filtration system for ultra-fine particle removal. W6. Preventive maintenance program.	• Increasing soda cooling-liquid time of use from 2 weeks to 3 or 4 weeks. • Reduction Na_2CO_3 and $NaNO_2$ consumption 1.5 to 2 times. • Lowering soda cooling-liquid waste-volley discharge 1.5 to 2 times. • Reducing water consumption from municipal water-supply system 2 to 4 times. • In case of additional treatment of soda cooling liquid by using membrane technique: ▫ increasing soda cooling-liquid time of use to more than 3 months; ▫ reduction Na2CO3 and NaNO2 consumption in 5-7 times; ▫ lowering soda cooling liquid waste volley discharge 5 to 7 times; ▫ reduction water consumption from municipal water-supply system 7 o 10 times.	H (W1) M (W2) M (W3) H (W4) M (W5) H (W6)
Facility-Wide Waste Discharge	• Facility is out of compliance partly due to limited analytical capabilities. • More than 50 percent spare capacity in existing (on-site) wastewater treatment facility.	W7. Adaptation of EPA or European test methods and instrumentation upgrades. W8. Feasibility study to assess utilizing spare capacity for treating other facility wastes.	• Improved control of wastewater discharges. • In case of treatment of similar cooling liquid wastes from others enterprises of the industrial region: ▫ environmental and social benefits; ▫ financial benefits from hazardous waste water treatment services.	H (W7) H (W8)

Table 2. Recommended Environmental Action Plan and Priority Pollution-Prevention Opportunities

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
LOW-COST/NO-COST AIR POLLUTION-PREVENTION OPPORTUNITIES			
A1. Floor-maintenance program. Shop is operating at 24 percent of capacity (i.e., it operates 40 hours out of a possible 168 hours per week). During downtimes, significant particulate matter (oil mist, metal dust, polishing solution mist) settles out. Current practice is to broom-sweep floors during weekends. This practice does not remove ultra-fine particulate matter that has settled and is removed too infrequently. During production, the settled solids are re-dispersed into the workroom air due to heavy traffic. Recommend purchase of two heavy-duty industrial vacuum-cleaner units and implementing a floor-maintenance program particularly in the polishing shop where highest sources of emissions are. These machines should also be used in the ring-machining (lathing) area.	From similar practices in other machining operations where oily mists and metal parts dusts occur, this practice can improve air quality from 5 to 10 percent. For maximum benefit, this practice should be combined with P2 recommendation A6.	Approximately US$500.	Improved air quality. There are no economic incentives beyond incremental improvement to worker productivity. This practice must be combined with other P2 recommendations for productivity improvements.
A2. Preventive maintenance program. Preventive maintenance program for leaks in ventilation system should be implemented. Local exhaust ventilation hoods are employed at 120 stations. The elements of this program are: 1. A statistically designed monitoring program. The optimum is approximately 15 percent of these exhaust locations to be semi-continuously monitored to a high degree. In particular, hood-face velocities should be measured and qualitative observations made of capture efficiency (e.g., high capture efficiency, moderate, low). The H, M, L may be numerically rated as 1, 2, 3 and in further increments. 2. A baseline control chart for each unit monitored should be developed to establish performance and variation. Control chart should cross-correlate between face velocity and capture efficiency.	This practice should conservatively improve air quality by as much as 50 percent based on similar programs.	At a minimum, a full-time engineer for 3 months to establish monitoring program and control charting. Thereafter, gradually reduce effort a part-time maintenance engineer.	Likely significant improvement to air quality and worker productivity. Major improvements likely for operating image of the shop.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
3. Once a baseline chart is established, begin identifying system losses. These will include holes in exhaust ductwork, leaking flanges, damaged hoods, and other areas. Implement corrective actions to those identified leaks. Leaks can be determined easily with a smoke- or silica-dust aspirator (easily made in the plant laboratory). Log location and nature of all corrective actions. 4. Control charting will track performance of corrective actions. Control chart improvements may then be extended to developing a facility-wide, regularly scheduled maintenance program. This program should include planned inspection and maintenance of section by section of ductwork and connections.			
A3. Intermittent exhaust operation. The bearing shop is divided into four work areas. There are several exhaust locations in addition to numerous local exhaust-hood locations. The air quality from visual observations is poorest in the central work area. At the southeast wall of the building are four wall exhaust fans located at ceiling level. These fans are only operated in the summer months, and rarely during the winter because of cold temperatures and because this part of the shop is underutilized. The fans are hooked up in series and shop personnel stated that when they are operated, air quality improves qualitatively by 10 percent or more in the central part of the shop. The P2 recommendation is: 1. Place the wall fans on an electronic timer so that they automatically turn on for brief periods of operation based on a schedule. The schedule will have to be determined by trial and error because there will be a trade-off between room temperature comfort and air quality. 2. Intake air fans should be placed on individual timers that are synchronized to turn on with the exhaust wall fans. This will prevent a negative pressure in the building.	Based on shop personnel observations, a 10 percent improvement in air quality in the central part of the shop could be achieved.	Estimated at less than US$1,000.	Likely significant improvement to air quality and worker productivity. Major improvements likely to operating image of the shop.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
A4. Automatic air-lock system. On the northeast side of the shop area building is a vapor wall that is maintained by a separate ventilation system. The vapor wall prevents cold air from entering through the double doors when loading and unloading operations take place or deliveries to and from the shop area are made. It is not cost-efficient to run the ventilation system continuously as is currently done. The P2 recommendation is actually an energy-efficiency recommendation with the environmental benefit of incrementally improving air quality in the workroom. The local ventilation can be controlled using an electronic relay switch that is triggered to turn on the ventilator with the opening of the double doors.	A very rough estimate is that the local ventilation system is likely operating about 30 percent more of the time than it should be (this should be better quantified by the enterprise by obtaining average estimates of the number of times and length of time the double doors are open during a day). A direct cost savings to the enterprise in terms of electrical consumption can be achieved by applying an electronic relay system. Total energy savings over the course of a year need to be quantified.	Estimated cost is about US$150.	Potentially a 30 percent savings in electrical energy for the local ventilator; plus freeing up personnel time to other shop floor tasks.
A5. Worker rotational assignments. Plant should consider establishing an Occupational Exposure Level (or TLV). Workers that are exposed to concentrations above the TLV for part of the day may be rotated to other job assignments or locations in the shop where the TLV is not exceeded. Provided that the average TLV for the day is within the established limit, the health risk will be lower.	This will limit occupational exposure to air pollution and is the lowest of the no-cost investments. It is considered by the team to have a low technical effectiveness rating because (1) there are few locations within the shop workroom area that have good air quality, and (2) shop management in general does not acknowledge the health risks to employees.	No cost.	Reduced occupational exposure and health risk at no cost.
LONGER-RANGE POLLUTION-PREVENTION OPPORTUNITIES			
A6. Polishing station local exhaust operation. Portable air-filtration units should be considered for the polishing machine stations which are the greatest source of emissions. A make-shift unit was installed and operated for two days and was found to be 100 percent effective in removing harmful vapors from the machine. The motor on the makeshift unit burned out due to operator negligence, but the principle was ade-quately demonstrated. The test not only showed that the air pollution problem was effectively eliminated, but indications are that substantial amounts of waste condensate are not collected and additional water-pollution problems will not be created. Condensate may be readily recycled to the machine with minor design adaptations. A vendor quote for a packaged unit capable handling up to 4 or more polishing stations at a time is being obtained, and will economize cost and use of floor space.	Elimination of the major emission source.	Likely to be cost-prohibitive to retrofit the entire shop. Recommend installation in stages and that the shop experiment with one unit first to determine effectiveness on the maximum number of polishing-station machines that can be handled by a single machine. One this is established, then multiple units may be considered to eliminate the air-pollution problem.	Likely to have a 70 percent improvement in air quality.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
A7. Intake air-filter cartridge replacement. Intake air-duct filter pads were removed because of blinding and never replaced. Exhausts are fairly close to intakes, so incoming air should be filtered. These should be purchased from an air-conditioning supply source and installed to provide fresh, clean air to the workroom.	The intake air supply is about 10 percent to the total room recirculation. The use of filters will have an incremental improvement to air quality, likely less than 10 percent.	Quotation from a Ukrainian Company is 80 Hrievnas per sq. m. One frame is 60 - 70 sq. m. Est. cost in Ru = 80 Hrv x 22.3 R/$ x 1$/3.81 Hrv = 468 Ru/sq.m. It is estimated that 15 frames will be needed. Hence, cost = 70 sq. m x 468 Ru/sq.m x 15 = 492,000 Ru (Hkarkovski Factory of Air Conditioners, Moscovski Prospect 257, Hkarkiv, Ukraine).	There are no direct cost savings but health risks will be reduced.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
A8. Ventilation system redesign. This will require a detailed assessment and major re-engineering.	Ultimate control of the problem. All other recommendations have a trade-off with air temperature (comfort) and do not completely eliminate or control the problem. Present system is old, in need of major repairs, and appears not to be properly designed, or at least designed without consideration for current production needs. Such an investment should only be considered after shop-management personnel are properly trained in developing preventive maintenance programs for such systems. Recommendation A6 should be developed as not only an exercise aimed at improving air quality, but in developing in-house expertise to address ventilation and air-quality control.	High. For a proper redesign and installation, including automatic temperature control, air balancing and flow adjustment, filtration, and ductwork construction, the cost will exceed US$2 million.	This is a long-term improvement to the operating facility and will depend on future growth and expansion.
LOW-COST/NO-COST WATER POLLUTION-PREVENTION OPPORTUNITIES			
W1. Use of sodium hydroxide (NaOH) to correct cooling liquid composition. The main reason for the sodium mixture becoming non-operational and its discharge to the sewage system every two weeks is accumulation of sodium hydrocarbonate which negatively influences the grinding (polishing) process. Accumulation of $NaHCO_3$ takes place as a result of CO_2 attraction from the air and hydrolyzation of $NaCO_2$ at high temperature during the process of polishing. It is suggested to reduce formation of $NaHCO_3$ in the mixture usage by correcting it with sodium hydroxide solution. Not only is the concentration of $NaHCO_3$ reduced but the concentration of sodium carbonate increases. This will allow the plant to do without soda when correcting the lubricating and cooling mixture during its usage. (Introduction of 1 g/l NaOH into the lubricating and cooling mixture when oversaturated with excessive sodium hydrocarbonate leads to the formation of 2.65 g/l of Na2CO3.)	This measure can create necessary conditions for prolonging lubrication cooling-liquids operation term from 2 weeks to 3 to 4 more. Thus the waste solution discharges into the urban (municipal) sewage system (made in volley modes) will be reduced at least 1.5 to 2 fold. Increased action effect under the given recommendation is achieved by combining it with actions in recommendations W2 and W3.	The expenses are insignificant. They are linked to carrying out necessary experimental-industrial tests, consuming additional reagents (NaOH) subject to equivalent decrease in consumption of sodium carbonate while adjusting (correcting) the solution, as well as creating necessary reagent facilities and metering devices.	Decrease in consumption of sodium nitrite and sodium carbonate for preparation of soda lubrication-cooling liquid is 1.5-2-fold. Possible annual saving by decreasing consumption of reagents (added to effects of recommendations W2 and W3) makes 150,000 Ru/yr.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
W2. Use of the urotropine as anti-bactericide agent. Another significant reason of soda lubrication-cooling liquid going out of service and its discharge into the sewage system is in-service bacterial pollution. The plant faces this phenomenon in summer when the temperature goes up (specific odor). The plant has vast experience using different bactericidal admixtures designed to prolong the service life of water-emulsion lubrication-cooling liquids which can be transferred onto the soda solution. Urotropine (which is already being used by the plant for treating packaging paper) is proposed to be used as one of such admixtures. Urotropine is known to be used as an admixture depressing biological processes in self-contained systems of recycled water supply.	The measure can allow more time in servicing the lubrication-cooling liquid from 2 to 3 to 4 weeks and more (refer to W1).	The expenses are insignificant. They are associated with carrying out necessary experimental industrial tests, consuming additional reagents (the cost of urotropine is insignificant if compared to other bactericidal admixtures), as well as creating necessary reagent facilities and metering devices.	Decrease in consumption of sodium nitrite and sodium nitrate for preparing soda lubrication-cooling liquid is 1.5 to 2-fold. Possible annual savings on decrease in consumption of reagents (added to effects of recommendations W1 and W3) makes 150,000 Ru/yr.
W3. Improvement cooling liquid-treatment technology. Use of the suitable coagulant (as PAA) to increase vacuum filter efficiency. Another significant reason of soda lubrication-cooling liquid going out of service and its discharge into the sewage system is accumulation of finely divided impurities with the elements being under 50 micrometers in size. Such impurities are probably not trapped by the existing vacuum filter; they are accumulated in the solution and deteriorate the quality of grinding considerably. The total amount of solid impurity elements in the circulating solution should not exceed 250-300 mg/l. To increase the service life of the lubrication-cooling liquid, additional periodic treatment of the solution is recommended during suspension of production which includes introduction of coagulant into the collecting reservoir, settling and coagulation of the sediment, decantation and recirculation of the solution, removal of sediment from the reservoir. Polyacrylamide (PAA) is proposed to be used as one of suitable and available coagulants having concentration of 5-10 mg/l. (Concentration of coagulant and other technological parameters of treating solutions are subject to adjustment according to pilot-test results.)	The measure can create necessary conditions for increasing time in service of the lubrication-cooling liquid from 2 to 3 or 4 weeks and more (refer to W1).	The expenses are insignificant. They are associated with carrying out necessary experimental-industrial tests, consuming additional reagents (e.g., polyacrylamide, the consumed amount of which is insignificant) as well as creating necessary reagent facilities and metering devices.	Decrease in consumption of sodium nitrite for preparing soda lubrication-cooling liquid is 1.5 to 2-fold. Possible annual savings on decrease in consumption of reagents (added to effects of recommendations W1 and W2) makes 150.000 Ru/yr.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
W4. Use of the steam condensate instead of fresh water for cooling liquid preparation. Excessive amounts of steam condensate are being discharged into the plant's sewage system. It is proposed to use this condensate for making soda lubrication-cooling liquid. At that weak a concentration, acid reaction of the condensate shall be neutralized by excess of sodium carbonate. Prevention of impacting the environment in this case is linked to decrease in urban (municipal) supply-system water consumption and corresponding decrease in wastewater discharge into the municipal sewage system.	Decrease in consumption of urban (municipal) water-pipe network and corresponding decrease in wastewater discharge into the urban (municipal) sewage system.	No cost. Insignificant costs may occur as a result of introducing changes into the engineering-service lines for feeding condensate into the reservoir to make lubrication-cooling liquid.	Economy results decrease from decrease in costs linked to water intake from the urban (municipal) water-pipe network (2.5 Ru/m3) and wastewater discharge into the urban (municipal) water-pipe network (1.3 Ru/m3).
W6. Preventive maintenance program. Monitoring and supervising the lubrication-cooling liquid losses program can play a major part in preventing impact on the environment and developing the ecological management system. The overall losses of soda lubrication-cooling liquid during one working day are about 15 percent, a considerable part of which relates to leakage from 653 equipment units. Below are the elements of such a program: 1. Determining the overall losses of lubrication-cooling liquid in the system and methods of measuring such losses 2. Determining the major sources of liquid losses associated with specific equipment and communication network 3. Rating the lubrication-cooling liquid losses 4. Keeping record of monitoring data 5. Developing and implementing methods of control of lubrication-cooling liquid losses	Receiving information necessary to schedule and carry out activities and events aimed at reducing losses of lubrication-cooling liquids that have a negative impact on the environment.	The costs are insignificant. The program under consideration can be carried out within plant specialists' job descriptions.	Carrying out the relevant monitoring program will make it possible to schedule goal-directed activities and events to reduce losses of lubrication-cooling liquids (amounting now up to 15 percent per day).

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
W7. Adaptation of EPA or European test methods and instrumentation upgrades. Industrial and sanitary laboratory available now at the plant is not supported by adequate technical and procedural facilities for carrying out efficient ecological monitoring including procedures necessary for developing activities within ecological management. It is proposed to make the *Investigation of Waste Waters Manual* as well as some analytic equipment available to the management of the plant responsible for carrying out ecological wastewaters monitoring.	Carrying out efficient ecological monitoring of lubrication-cooling liquids and petroleum-oils losses.	US$500	Additional profit generation owing to scheduling and implementing programs of decreasing recirculation rates of lubrication-cooling and other technological liquids and reducing their losses.

Pollution-Prevention Recommendation	Environmental Benefit	Estimated Cost	Estimated Savings or Economic Benefits
W8. Feasibility study to assess utilizing spare capacity for treating other facility wastes. By now the plant has at its disposal contemporary facilities for treating industrial wastewater with the total capacity of 2,200 thousand m^3 per year (the existing industrial wastewater discharge into the sewage system makes 480 thousand m3 annually). The water-treatment plant is not put into operation to its full capacity and is used only for treating water, oil, emulsion waste (10 thousand m3 annually), chrome-containing waste (1,000 m3 annually), and for regeneration of waste petroleum oils (550 t annually). At that capacity the available treatment facilities (designed to rectify the above types of wastewater and regenerate waste oils) are under-loaded by around 50 percent. It is proposed to consider the possibility of carrying out an appropriate feasibility study for treating at the plant compositionally similar wastewater and waste petroleum oils generated at neighboring enterprises of the industrial district.	Solving problems linked to prevention of impacting the environment on the regional level. Reduction of untreated lubrication-cooling liquids discharge into the urban (municipal) water-pipe network at other enterprises of the industrial district. The total reduction of discharge amounts will correspond to wastewater amount received for treatment from outside.	No cost.	Additional profit generated from payments for treating wastewater (lubrication-cooling liquids) and regenerating waste oils.
LONGER-RANGE POLLUTION-PREVENTION OPPORTUNITIES			
W5. Use of in-line filtration system for ultra-fines removal. By now, one of the most promising directions of increasing recirculation efficiency (and consequently preventing impact on the environment) of such technological liquids as lubrication-cooling solutions and emulsions, petroleum oils, and pickling solutions is application of diaphragm technologies. Similar technologies and equipment shall be used for elimination of poor-pressing suspended particles and microorganisms from soda lubrication-cooling liquid. The said operation shall be carried out following the W1-W3 recommendations, considering the results achieved.	The measure can create the necessary conditions for increasing time in service of the lubrication-cooling liquid from 3 to 4 weeks to 3 and more months. Estimated reduction of the used solution discharges into the urban (municipal) water drain (made in a volley) will be reduced 5 to 7-fold in comparison with the present level.	The expenses are significant. They are associated with carrying out necessary design work, and purchasing and mounting equipment. A vendor quote for a typical unit was obtained from Ariad. Cost is about $13,000. The overall pay-off period (i.e., ROI) of this project is less than 2 years. Refer to Annex B for detailed vendor information.	Decrease in consumption of sodium nitrite and sodium carbonate for preparation of soda lubrication-cooling liquid is 5-7-fold. Decrease in consumption of reagents (added to effects of recommendations W1, W2, and W3) effects in estimated annual saving of 500-700 thousand Ru/yr.

ANNEX A

Pre-Assessment Pollution-Prevention Questionnaire

ANNEX A

Pre-assessment Pollution — Prevention Questionnaire

Pre-assessment Pollution Prevention Questionnaire for the Bearing Plant

ITEM	INFORMATION REQUIRED	DATA
	I. Process Operating Characteristics and Productivity Levels	
I.1	What is the length of time of a typical operating shift (e.g., 8 hours, 16 hours, 24 hours per day, other)?	
I.2	How many operators are required per shift?	
I.3	How many hours throughout the year represent production?	
I.4	How many hours per year is the operation shut down for maintenance reasons?	
I.5	How many hours per year is the operation shut down due to seasonal business restrictions?	
I.6	What is the design capacity of the operation (i.e., how many units of product is the process designed to produce)?	
I.7	What are total production capacities for the last 3 years (i.e., number of units finished product for 1998, 1997, 1996)? Give outlook production (projections) for 1999.	
I.8	List reasons for shift (production) interruption and downtimes.	
I.9	Does loss of product or raw materials occur? If so, typically how much per week or what percentage of yearly production capacity? What are the reasons for these losses?	
I.10	What are the raw material costs (provide an itemized list with average unit prices)?	
I.11	What are typical maintenance and equipment parts replacement costs throughout a year?	
	II. Process and Product Quality Control and Assurance Characteristics	
II.1	What product-quality control tests are conducted and what is the frequency of these tests?	
II.2	How much below-standard product is produced in a year and why?	
II.3	Is any control charting done for product-quality control parameters? If so, provide typical charts.	
II.4	Is any control charting done for process-control parameters? If so, provide typical charts.	
II.5	What are the parameters controlled in a production shift?	
II.6	How much operator attention is required to control the process (e.g., continuous, intermittent - provide typical percentage or fraction of shift time devoted to control)?	

ITEM	INFORMATION REQUIRED	DATA
	III. Energy Efficiency Characteristics	
III. 1	Are there pumps used in the operation? How many pumps are used and for what purposes? What type of pumps are used (e.g., centrifugal, positive displacement, metering, other)?	
III. 2	If pumps are used, how are flow rates metered and controlled?	
III. 3	If pumps are used, what types of drives are used (variable speed or constant)?	
III. 4	If pumps are used, what are the capacities of these units?	
III. 5	List all sources of energy consumption required to run the process. For example: a. electricity consumption for bottling machines b. electrical consumption for pumps c. electrical consumption for lighting d. electrical consumption for ventilation e. heat for work-room environment f. other	
III. 6	What is the unit cost for electricity and heating?	
III. 7	What energy-measuring devices (if any) are used and how often? Has an energy audit ever been performed?	
III. 8	Are the walls of the shop area insulated? Give characteristics of construction (e.g., brick walls, stucco walls, other and the approximate thickness of the walls).	
III. 9	What type of ventilation is provided in the shop area (natural, forced draft, other)?	
III. 10	What are the approximate dimensions or total volume of the shop area?	
III. 11	How many times in an hour is the volume of air displaced in the shop area?	
III. 12	Is the air temperature of the shop area measured and is it regulated?	
III. 13	Is there any hydraulic equipment used in the operation? (if so, list it)	
III. 14	Is there any hydraulic equipment used in the operation? (if so, list it)	
	IV. Environmental Management Characteristics	
IV. 1	What environmental permits are there for the shop operation?	
IV. 2	List all waste categories and classes of wastes. Organize the list into three categories: Water Discharges, Solid Waste, and Air Emissions.	
IV. 3	Provide waste-reporting forms or a summary of the amounts of each type of waste produced per year. Provide this data for 1998, 1997, and projections for 1999.	

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ITEM	INFORMATION REQUIRED	DATA
IV. 4	Describe how wastewater is handled. Is it treated on site; is it sent to an off-site treatment facility; is it discharged directly to sewer or surface body of water?	
IV. 5	Describe how solid wastes are disposed of. Are they stockpiled on-site? If so, are they stored together in one place/container or separated by waste type? Are wastes removed to a disposal or recycling facility? If so where and to what type of facility?	
IV. 6	Is there any form of recycling in the shop operation? Describe what is done and give an estimate of the amounts of materials recycled during a year.	
IV. 7	Are there any pollution-control devices used in the shop operation? What are they and are they functioning?	
IV. 8	Is oil used for machine lubricating or heating purposes in the shop area?	
IV. 9	Are there oil losses in the shop operation? Describe them.	
IV. 10	If oil is used, how is inventory maintained? Are there above ground or underground storage tanks, or is oil stored in barrels? How much is typically kept in store throughout the year?	
IV. 11	Are there any small emissions that you are aware of ? Describe these losses and frequency of occurrence.	
IV. 12	How often is the facility inspected by the Samara Ecological and Environmental Protection Council? When was the last inspection, and were there any citations, fines, or corrective actions?	
IV. 13	Have there been any major fires or spills in the shop area within the last three years? If so, describe what happened.	
IV. 14	Do any of the wastes have a value and if so how much?	

ANNEX B

Vendor Quotations and Equipment Specifications

APPENDIX B

VENDOR QUOTATIONS AND EQUIPMENT SPECIFICATIONS

Межрегиональная общественная организация

ПОВОЛЖСКОЕ ОТДЕЛЕНИЕ
РОССИЙСКОЙ ИНЖЕНЕРНОЙ АКАДЕМИИ

443001, г. Самара, Студенческий пер., 3-а, Тел/факс (8462) 42-04-39, 32-22-17, ИНН 6315941852
E-mail: root@engacad,samara.su, р/счёт № 4070.3810.4000.0000.0004 ф-л "Самарский" в КИБ "Альфа-Банк" г.Самары, БИК 043601964, к/счёт № 3010.1810.6000.0000.0914,ОКОНХ 95111, ОКПО 10992310

Исх.№ _____ от _____

To	Sales Rep. – K. Amiad	**From**	Nick Cheremisinoff – Project Manager
Date	March 13, 1999	**Fax #**	972-6-690-9391
Subject	Information and Quote on SAF Automatic Filter Unit	**Response**	URGENT

facsimile

Dear Sir or Madam:

We are trying to spec out and obtain cost information for an automatic filtration system. The SAF automatic filter series may fit our needs. The application is in a bearing plant in Samara, Russia. We are re-circulating a polishing fluid solution to a battery of surface polishing machines for small bearings. Machine fouling is a problem due to particulate matter that is 50 microns in size and smaller. The particulate matter is abrasive in nature (typically metal surface filings and some sodium salt scale from our polishing solution). We are not sure yet of the concentration of these particles but are obtaining data. Temperature of fluid is maximum 30 degrees Celsius and fluid consistency is that of water, and Newtonian. Our flowrates are 450 cubic meters per hour and maximum working pressure is around 3 to 4 bar.

Can you provide us by facsimile, the following information?

1. Your recommendation of a unit. The SAF 6000 series seems like it might be appropriate but flow rate is a bit low. What we are considering is using this machine in a by-pass stream, but you might have an alternative suggestion for us;
2. Specs on your recommended machine and filter media;
3. Cost of your recommended unit (FOB). Please identify for us closest location of your supplier;
4. Estimated availability (how long for delivery from time of PO, and the terms of payment;
5. The maximum solids loading that the machine will accept;
6. The particulate removal efficiency we may expect or be guaranteed by the machine.

We would greatly appreciate your immediate response to these queries.

Thank you for your attention to this matter and we look forward to receiving information on your product.

Very truly yours,

Nicholas P. Cheremisinoff

Nicholas P. Cheremisinoff, Ph.D.

amiad, d.n. galil elyon 1,
12335, israel
Tel: +972-6-693-3500
Fax: +972-6-690-9391
E-Mail: mrkting@amiad.co.il

amiad filtration systems (1997) Ltd.

To: **VOLGA DEP. OF RUSSIAN**
Att: **MR. NICK CHEREMISINOFF**

Date: 22 March 1999

RE: Your request for automatic filter solution.

Dear Mr. Petrov,

Thank to your e-mail, please accept our apologies for the delay in our replay.

Attached our recommendations:

- The SAF 6000 is suitable for a side stream application around 20% of the total flow.
- Spec for the filter attached.
- Cost of the unit please sees attached quotation.
- We have distributors in Finland, Germany, Denmark, France and all over Europe. For further information on particular distributors do not hesitate to contact me.
- Availability and terms of payment are on our quotation NO. 101-2149.
- The maximum solid the 6" SAF 6,000 will accept for 50 micron is 70 PPM. However this depends on particle size distribution.
- Particle removal efficiency is 99 % for over 50 micron however this again depends on particle size distribution.

Please note that if you wish to filter the entire flow we will suggest 2 x EBS filters with 50-micron screen. Attached technical data sheet for the EBS.

Please indicate if you wish to receive more information about our complete product range.

For further assistance do not hesitate to contact me.

Kind regards

Rebecca Orlans
Marketing manager

Best regards

Rebecca Orlans
Marketing manager

12335, israel
tel: +972-6-693-3500
fax: +972-6-690-9391
e-mail: mrkting@amiad.co.il
exporter no.: 51-249769-4

amiad filtration systems (1997) Ltd.

VOLGA DEPTARTMENT OF RUSSIAN
ENGINEERING ACADEMY
STUDENTCHESKI PER. 3A
SAMARA , 443001
RUSSIA
ATT: MR.NICHOLAS P.CHEREMISINOFF

DATE:22.03.99
YOUR REF:6"SAF 6000
CUSTOMER NUMBER:190101
OUR REF:Q-101/2149

QUOTATION:Q-101/2149

QUANT	DESCRIPTION	DETAILS	OLD CAT NO.	NEW CAT.NO.	PER UNIT	TOTAL
1	6"SAF 6000 AUTO FILTER,EU		2-64-062-9	03-3061-1120-3500	8,184.00	8,184.00
1	SAF 6000 FILTER-WEAVEWIRE SCREEN	50 MICRON		13-3083-0005	2,496.80	2,496.80
1	PLC CONTROL BOARD D-97 FOR SAF	THREE PHASE		82-81-4350-0271	2,032.00	2,032.00
3				F.O.B	TOTAL US $	12,712.80

WE ARE PLEASED TO OFFER YOU THE ABOVE QUOTATION.

DELIVERY TIME ..3....WEEKS EX FACTORY,FROM OFFICIAL ORDER.

TERMS OF PAYMENT:PREPAID

PAYMENT THROUGH BANK BANK HAPOALIM BM.A/C 136600,BRANCH 542,ROSH PINA,ISRAEL.

VALIDITY UNTIL :22.06.99

PLEASE REFER TO OUR REFERENCE NUMBER ON ALL CORRESPONDENCE.

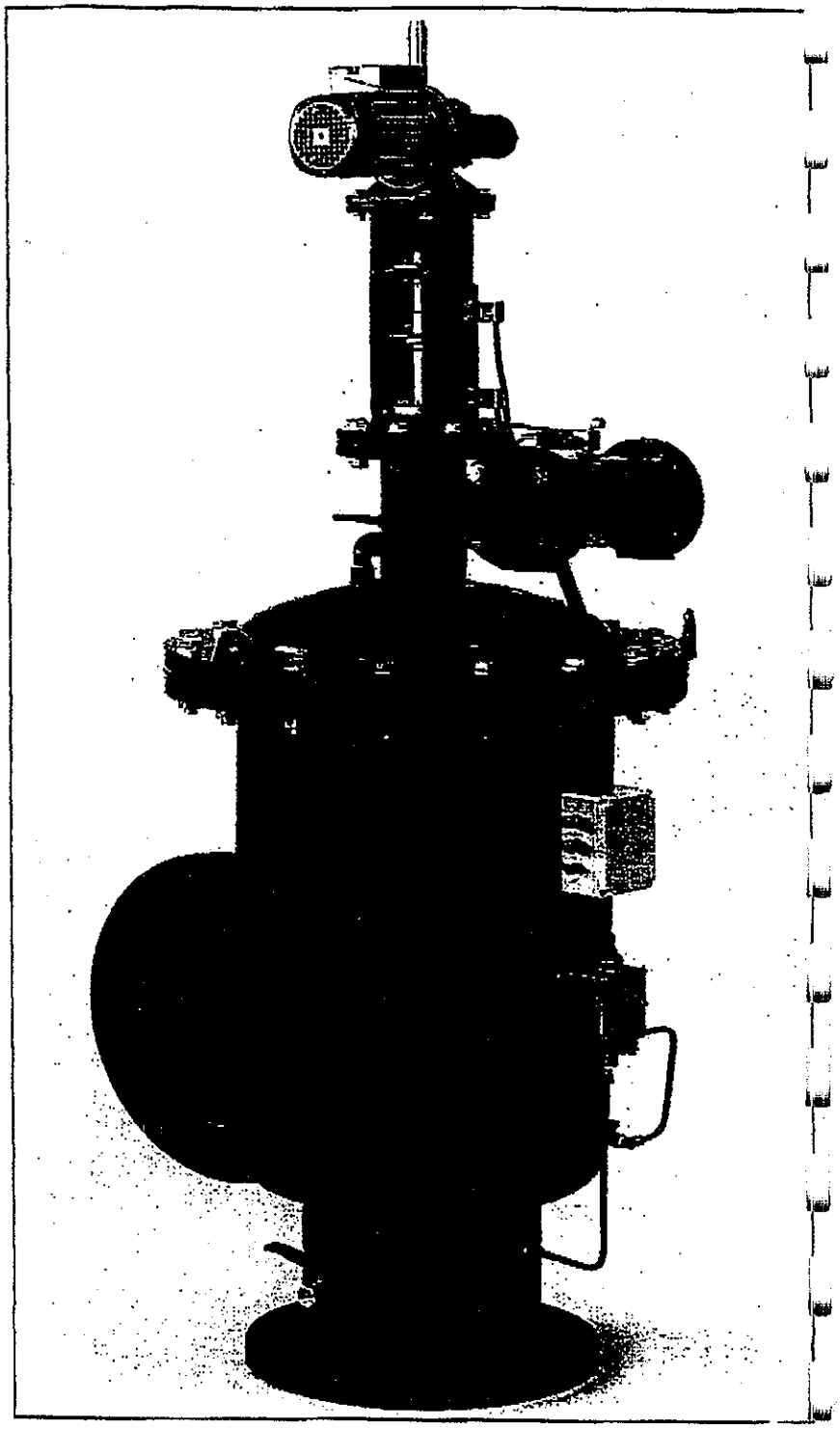
R.Ovdar

CM/AMIAD FILTRATION SYSTEMS LTD.

AMIAD "EBS" FILTERS

8"-14" Automatic Filters, for flow rates up to 1000 m^3/h; 4400 Usgpm

The Amiad automatic self-cleaning filters, for high flow rates and a larger filtration area.



Features:

- For flow rates up to 1000 m^3/h; 4400 Usgpm.
- Filtration range: from 3500 to 10 micron.
- Large filter area: 10,000 cm^2; 1550 in^2.
- Two cleaning methods: Brushes or Scanner.
- Electronically monitored cleaning cycle flexibility of control options.
- Flushing according to pressure differential and/or according to time. Option for continuous flushing.
- Minimum water wasted during flushing.
- No interruption of flow downstream during flushing.
- Applications:
  -Water supply systems
  -Cooling water
  -Waste water

  in: Steel industries, Pulp & Paper, Food processing, Plastic industry, Mining, Irrigation, etc.

How the "EBS" filter works

The EBS is an easy-to-operate automatic self-cleaning filter. The EBS is designed to work with various types of screens in filtration degrees from 3500 to 10 micron, and is available in 8", 10", 12" and 14" inlet/outlet diameter.

Filtering process:

The water flows through the stainless steel cylindrical filter element from inside out, creating minimal head loss. Different types of screens are available for different filtration needs.
The "filtration cake" accumulating on the screen surface causes head loss to develop across the screen. When this head loss reaches a pre-set value, the cleaning mechanism is operated.

Self-cleaning process:

One of two methods of self-cleaning may be selected, depending on the required degree of filtration: **Coarse** (3500-200 micron) or **fine** (800-10 micron).

Coarse filtration – Brushes.
The brushes are a construction of stainless steel, driven by a 1 1/2 HP electric motor. The brushes revolve along the screen, thus removing the filter cake, which is then discharged through an exhaust valve for a duration of 15 to 20 seconds.

Fine filtration – Suction scanner.
The suction scanner is a stainless steel construction, driven by a ½ HP motor. Its hollow nozzles scan the screen surface in a spiral motion, sucking-in the filter cake, in a controlled motion, without touching the screen. Suction power is achieved due to low pressure conditions created by the exhaust valve opening to the atmosphere. The filter cake is then discharged through the open exhaust valve. Cleaning takes between 35 to 40 seconds.

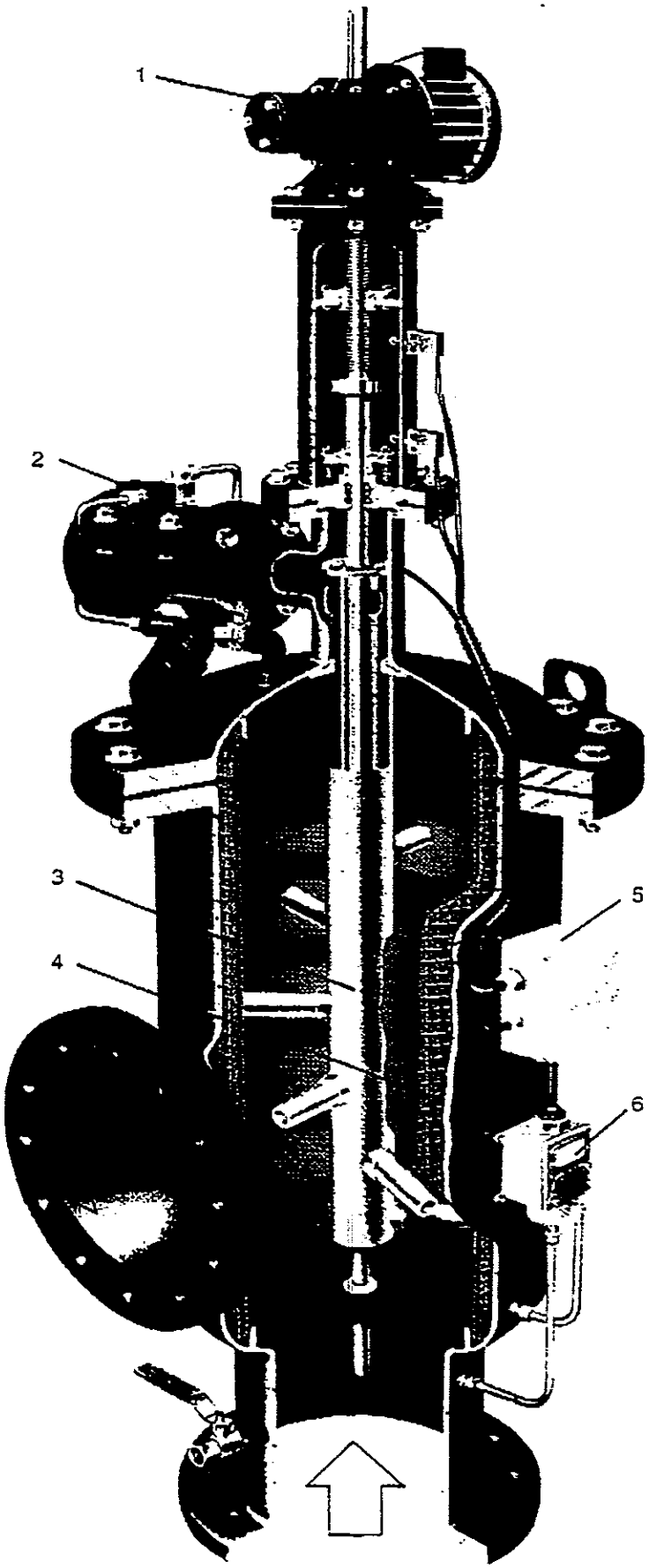
The self-cleaning process begins when the pressure differential across the screen reaches a pre-set value or a predetermined lapse of time. During the self-cleaning process filtered water continues to flow downstream of the filter.

Control system:

The EBS filter is equipped with a pressure differential switch that transmits an electric signal to the electronic control board, which initiates the flushing cycle.
A solenoid operates the exhaust valve by means of a hydraulic command or compressed air.

Features:

- Flushing according to pressure differential and/or according to time.
- Option for operation of continuous flushing.
- Flushing counter
- An alarm or an alternative reaction in malfunction mode (open a bypass, shut-off a pump, operate an alarm signal in control room, etc.).



1. Drive unit
2. Exhaust valve
3. Suction scanner
4. Weavewire screen
5. Wiring box
6. Pressure differential switch

Technical specifications

General

Maximum flow rate	1000 m^3/h	4400 USgpm	Consult manufacturer for optimum flow depending on filtration degree & water quality.
Min. working pressure	2 bar	30 psi	or lower if pressure is increased for flushing.
Max. working pressure	10 bar	150 psi	16 bar = 240 psi upon request.
Filter area	10,000 cm^2	1550 in^2	
Inlet/Outlet diameter	200,250, 300 & 350 mm	8", 10", 12" & 14"	Flange standards as per request.
Filter housing	500 mm	20"	Epoxy-coated steel, or other on request.
Max. working temperature	80°C	176°F	
Weight	200 mm = 310 Kg	08" = 680 lb.	
	250 mm = 325 Kg	10" = 715 lb.	
	300 mm = 350 Kg	12" = 770 lb.	
	350 mm = 380 Kg	14" = 840 lb.	

Flushing data

Exhaust valve	80 mm	3"	
Wasted water per cycle	500 liter	132 gallon	at 2 bar = 30 psi
Minimum flow for flushing	50 m^3/h	220 USgpm	at 2 bar = 30 psi
Flushing cycle time	Scanner: 35-40 Seconds		
	Brushes: 15-20 Seconds		

Control and electricity

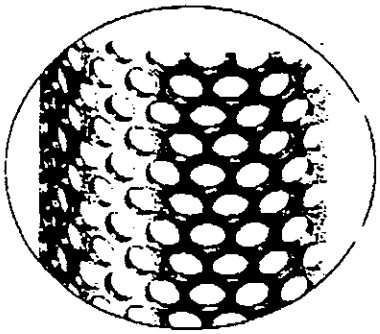
Control voltage	24V AC (12V or 24V DC upon request)
Electric motor	Scanner: 1/2 HP; 18/22 Gear output R.P.M.
	Brushes: 11/2 HP; 14 Gear output R.P.M.
Rated operation voltage	3 phase 220 / 380 / 440 V; 50 / 60 Hz
	Single phase: 110 / 220 V; 50 / 60 Hz
	DC: 12V or 24V (upon request)
Current consumption	Scanner: 1.5 Amp. (DC option 16 Amp.) Brushes: 4.0 Amp.

Construction materials*

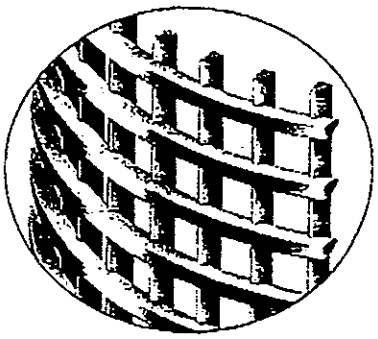
Filter housing and lid	Epoxy-coated carbon steel 37-2 (Stainless Steel 316 available on request).
Screens	Stainless Steel 316 (Perforated, Wedgewire or Weavewire).
Cleaning mechanism	Scanner: Stainless Steel 316, POM
	Brushes: Stainless Steel 316, PVC
Exhaust valve	Epoxy-coated cast iron, Natural rubber
Seals	Synthetic rubber, Teflon
Control	Aluminum, Brass, Stainless Steel, PVC

*Amiad offers a variety of construction materials. Consult the manufacturer for specification.

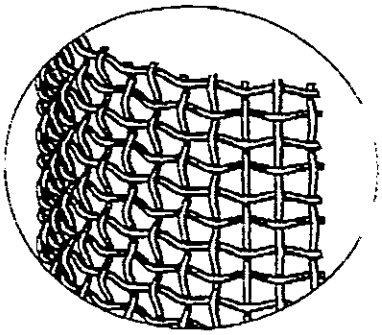
Screen types



Perforated Cylinder



Wedgewire screen

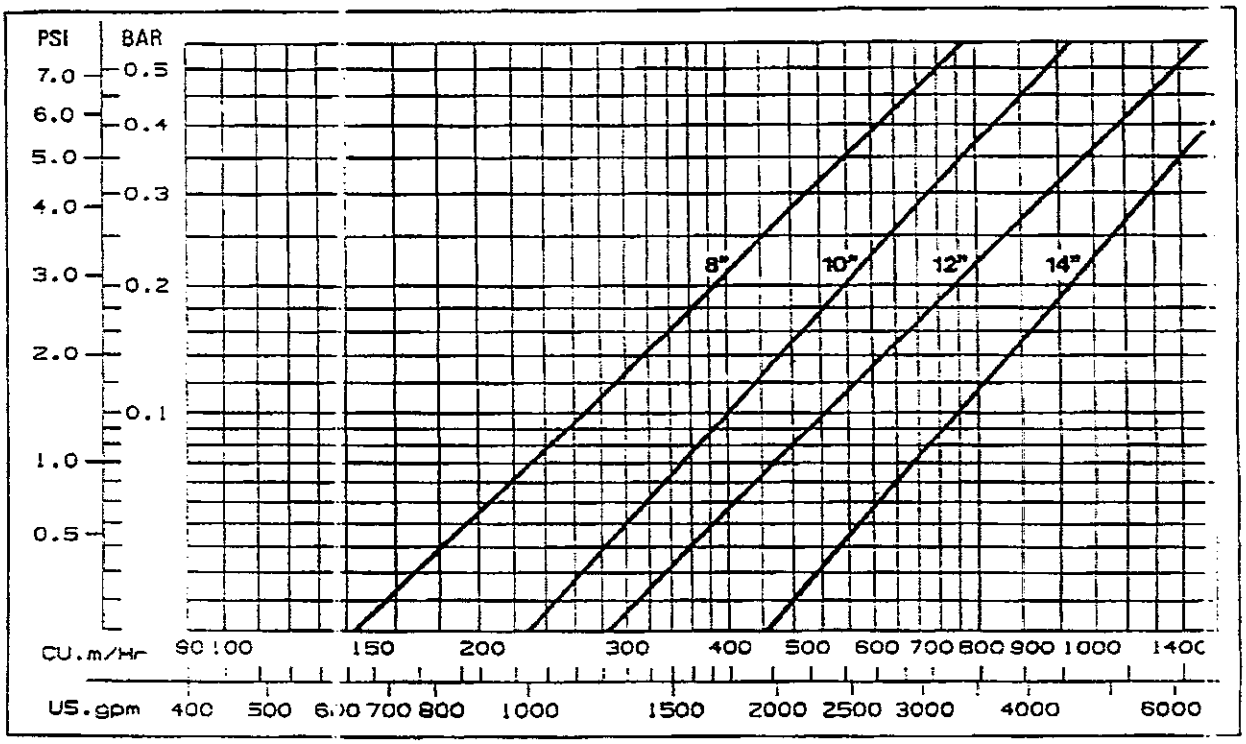


Weavewire screen

Standard filtration degrees

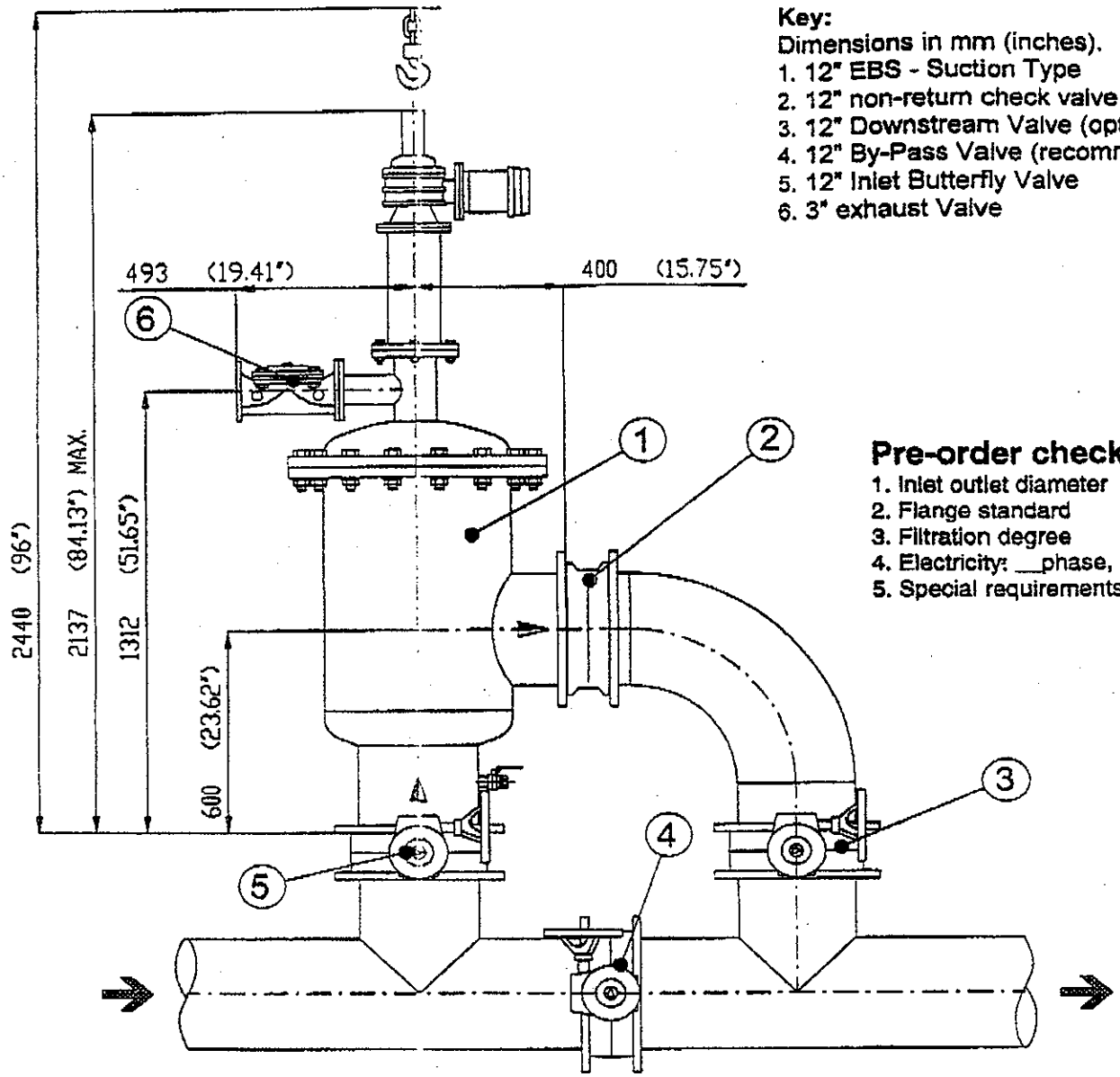
Cleaning method	Stainless steel brushes							Suction scanner									
Screen type	Perforated cyl.			Wedgewire Screen				Weavewire Screen									
micron	3500	2500	1500	800	500	300	200	500	300	200	130	100	80	50	25	[illegible]	
mm	3.5	2.5	1.5	0.8	0.5	0.3	0.2	0.5	0.3	0.2	0.13	0.1	0.08	0.05	0.02	[illegible]	
mesh	4	6	10	20	30	50	75	30	50	75	120	155	200	300	450	[illegible]	

Pressure loss graph



Measured with Suction type, 130 micron.

Suggested installation



Key:
Dimensions in mm (inches).
1. 12" EBS - Suction Type
2. 12" non-return check valve (required)
3. 12" Downstream Valve (option)
4. 12" By-Pass Valve (recommended)
5. 12" Inlet Butterfly Valve
6. 3" exhaust Valve

Pre-order check list:
1. Inlet outlet diameter
2. Flange standard
3. Filtration degree
4. Electricity: __phase, __V, __ Hz
5. Special requirements

AMIAD products undergo constant monitoring for quality control. The manufacturer reserves the right to incorporate changes and improvements in the product without prior notice.

Ref. 95-044-340-002/1 1/98

amiad filtration systems

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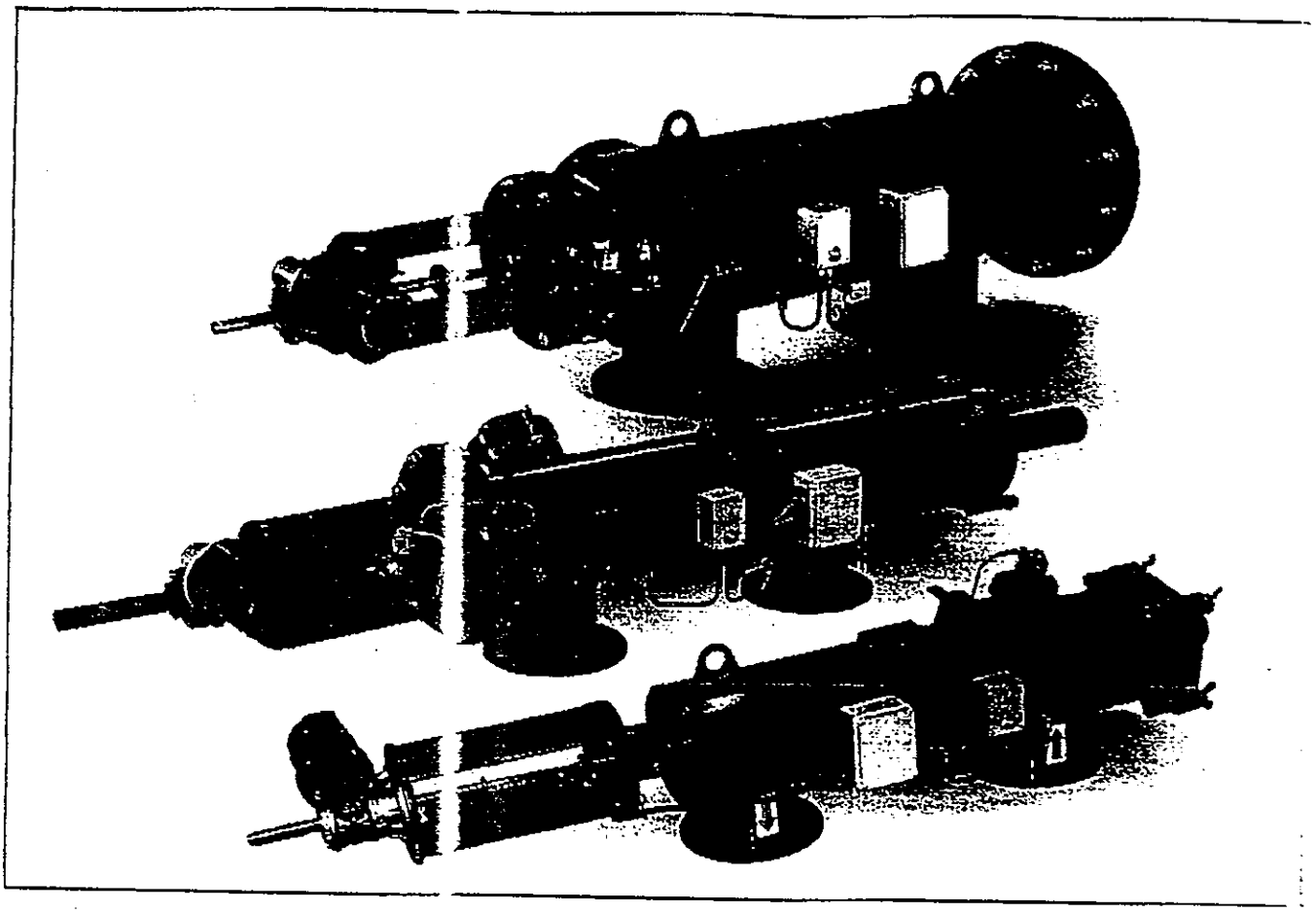
www.amiad.co.il

AMIAD "SAF" FILTER SERIES

3" - 10" Automatic Filters for flow rates up to 400 m³/h



The Amiad automatic self-cleaning electric filters that are suitable for more applications than ever.

Features:

- For flow rates up to 400 m³/h
- Large filter area: 3000, 4500 and 6000 cm²
- Minimum water wasted during flushing. Less than 1%
- No interruption of downstream flow during flushing.
- Flushing according to pressure differential and/or according to time. Option for continuous flushing
- Filtration degrees from 500 to 0 micron.
- Electronically monitored cleaning with flexibility of control options.
- Applications:
  -Water supply systems
  -Cooling water
  -Waste water
  in:
  Steel industries, Paper mills, Car manufacturers, Food processing, Plastic industry, Mining, Drinking water, Irrigation, Golf courses, etc.

amiad filtration systems

How the "SAF" filters work

The SAF filter series are sophisticated yet easy-to-operate automatic filters, with a self-cleaning mechanism driven by an electric motor.The SAF is designed to work with various types of screens in filtration degrees from 500 to 10 micron, and is available in 3"-10" inlet/outlet diameter.

The water enters through the inlet pipe into the coarse screen from outside in, and through the fine screen from inside out. The "filtration cake" accumulates on the fine screen surface and causes head loss to develop.

The coarse screen is designed to protect the cleaning mechanism from large dirt particles.

Self-cleaning process:

The SAF filter starts the self-cleaning process when the pressure differential across the screen reaches a pre-set value or a predetermined lapse of time.

Cleaning of the filter element is carried out by the suction scanner which rotates in a spiral movement while removing the filtration cake from the screen and expels it out through the exhaust valve. During the self-cleaning process, which takes between 20 and 40 seconds, filtered water continues to flow downstream.

Control system:

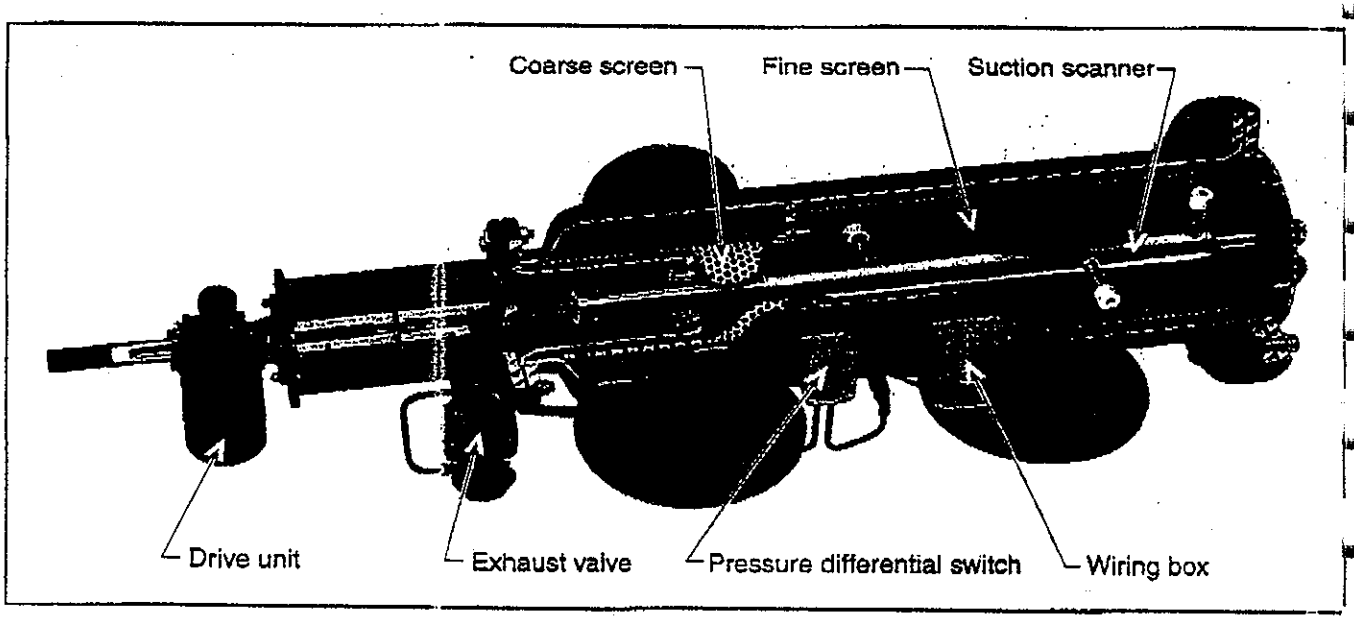
Two types of control boards are available for the SAF filters. PLC type and Relay type.

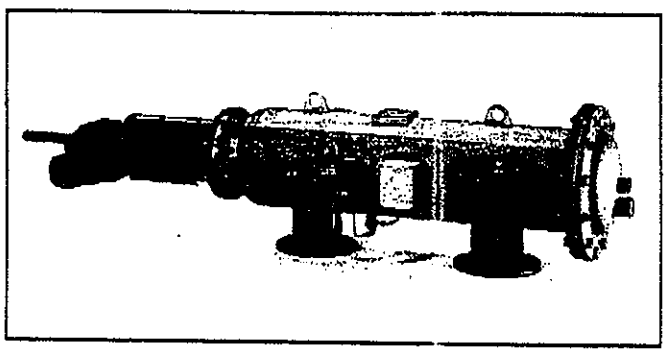
Features:

- Flushing according to pressure differential and/or according to time.
- Option for operation of continuous flushing.
- Flushing counter.
- An alarm or alternative reaction in malfunction mode (open a by-pass, shut-off a pump, operating an alarm signal in a control room, etc.)

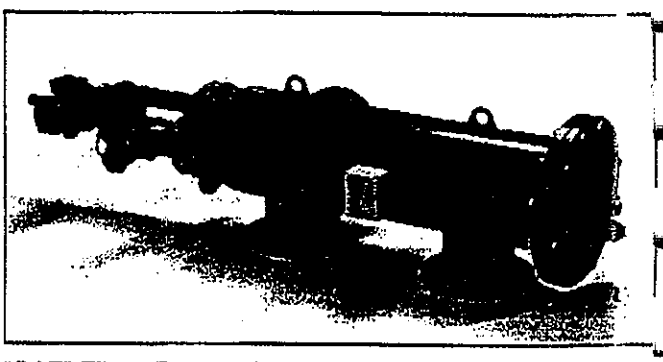
The "SAF" advantages:

- Its large filter area, reliable operating mechanism and simple construction, makes the SAF filter the ideal solution for filtration of low quality water to the very fine filtration degrees.
- Minimal flushing flow rate required: Perfect cleaning even with marginal pressure conditions.
- Minimal quantity of flushing water allows operation in continuous flushing mode without losing much water and without interrupting the water supply downstream.





"SAF" Filter, Stainless steel



"SAF" Filter, Rubber lined

Technical specifications

General

Filter type	SAF-3000	SAF-4500	SAF-6000	
Maximum flow rate [m³/h]	150	250	400	Consult manufacturer for optimum flow depending on filtration degree & water quality.
Min. working pressure [bar]	1.5	1.5	2	Lower if increased for flushing.
Max. working pressure [bar]	10	10	10	16 bar upon request.
Filter area [cm²]	3000	4500	6000	
Inlet Outlet diameter [mm]	80,100,150	100,150,200	150,200,250	Flange standards as per request.
Housing diameter [mm]	250	250	350	
Max. working temp. [°C]	80	80	80	
Weight [kg]	80mm=105 100mm=110 150mm=115	100mm=150 150mm=156 200mm=165	150mm=240 200mm=245 250mm=260	

Flushing data

Exhaust valve [mm]	50	50	50	
Flushing cycle time [sec.]	20	20	40	
Wasted water per cycle [lit.]	64	83	280	at 2 bar
Min. flow for flushing [m³/h]	11	15	25	at 2 bar

Control and electricity

Electric motor [HP]	1/4	1/4	1/3	
Control voltage [V]	24 AC	24 AC	24 AC	12V or 24V DC upon request.
Rated operation voltage	3 phase, 220 / 380 / 440 V 50/60Hz			12V or 24V upon request.
Current consumption [Amp.]	0.6	0.6	0.8	With 3 phase 380 / 440 V

Construction materials*

Filter housing	Carbon steel 37-2. Phosphate pre-treated polyester coating.		
Filter lid	SMC polyester	Carbon steel, Polyester coating	
Screens	Stainless steel 316		
Cleaning mechanism	Stainless steel 316, POM		
Exhaust valve	Epoxy-coated cast iron, Natural rubber		
Seals	Synthetic rubber, Teflon		
Control	Aluminum, Brass, Stainless steel, PVC		

*Amiad offers a variety of construction materials. Consult manufacturer for specifications.

Standard filtration degrees

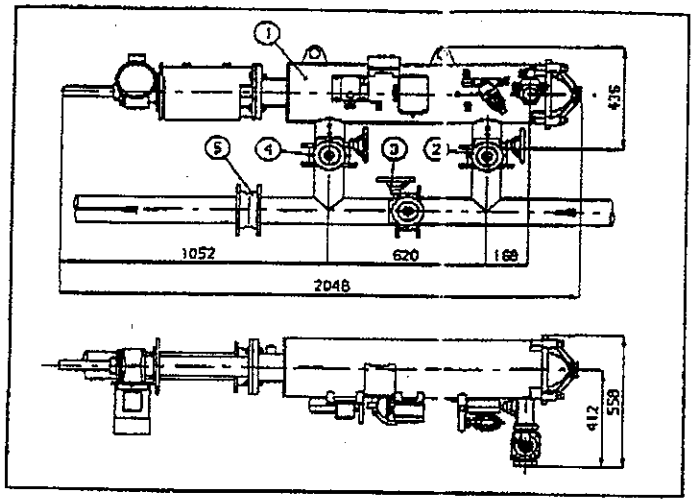
	Stainless steel weavewire screen								
micron	500	300	200	130	100	80	50	25	10
mm	0.5	0.3	0.2	0.13	0.1	0.08	0.05	0.02	0.01
mesh	30	50	75	120	155	200	300	450	600

Key to installation drawings:
Dimensions in mm
1. SAF Filter
2. Inlet butterfly valve
3. Bypass valve
4. Downstream valve
5. Non-return check valve

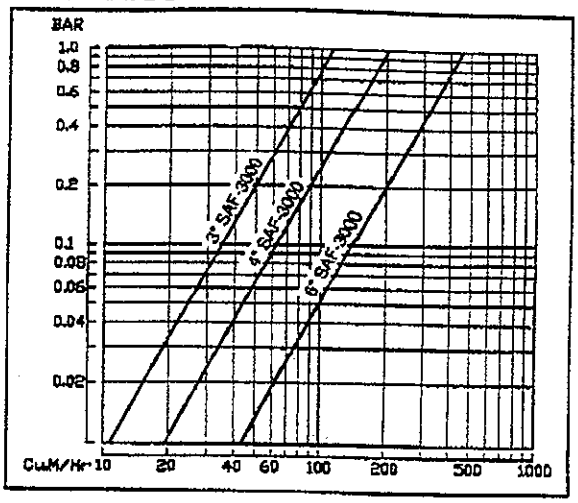
Suggested installations

Pressure loss graphs

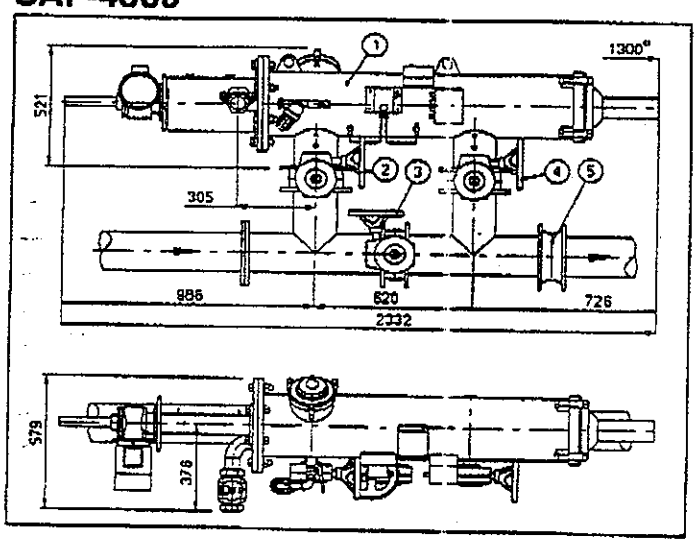
SAF-3000



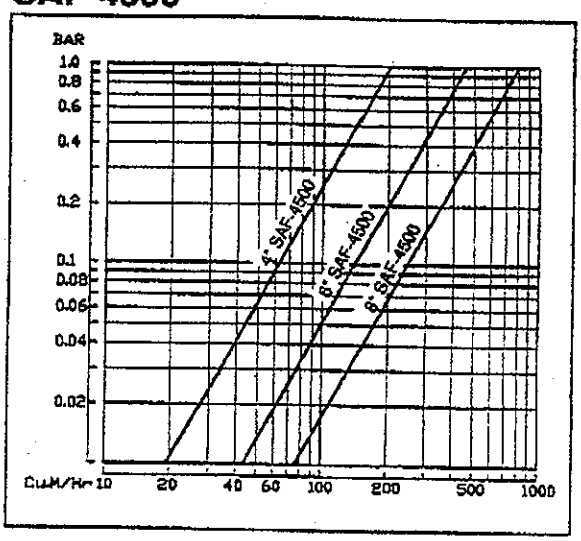
SAF-3000



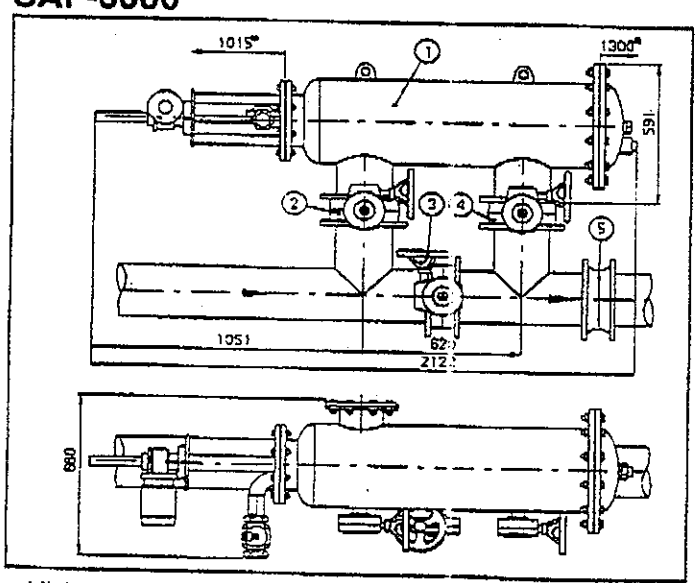
SAF-4500



SAF-4500

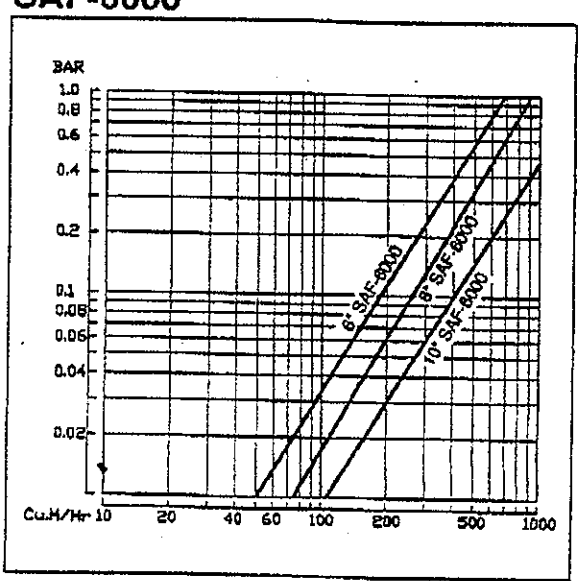


SAF-6000



* Minimum length for opening

SAF-6000



Measured with 130 micron screen

35

Приложение

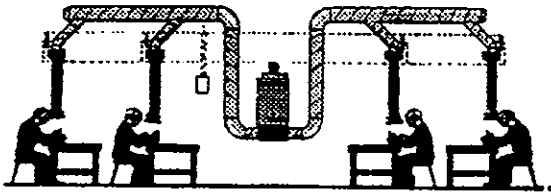
SovPlym

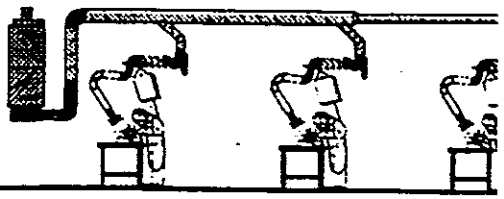
Российско-шведское предприятие

ЭЛЕКТРОСТАТИЧЕСКИЕ ФИЛЬТРЫ EFO

CE ISO 9001

СП "СовПлим" предлагает Вашему вниманию электростатический фильтр **EFO** шведской фирмы "PlymoV предназначенный для очистки воздуха от масляного тумана. Фильтр разработан совместно с фир "VOLVO" и работает по принципу осаждения в электростатическом поле. Уникальная комбинация мех ческого и электростатического способов очистки обеспечивает максимально эффективное улавлив взвешенных в воздухе частиц масла.





КРАТКОЕ ОПИСАНИЕ ОСНОВНЫХ КОНСТРУКТИВНЫХ ЭЛЕМЕНТОВ

1. **EFO-2000** - Фильтр (макс. расход воздуха 1800 м³/ч) для очистки воздуха от масляного тумана. Содержит фильтр предварительной очистки, а также ионизационную, осадительную ячейки и приемную камеру с входн патрубком Ø 160 мм, дренажом и поддоном для сбора масла. **EFO-2002/AL** - фильтр с сигнализацией.
2. **EC-2000** - Осадительная ячейка для EFO-2000 содержит 49 осадительных пластин. Активная фильтрующая поверхность 9,6 м².
3. **IOO-2000** - Ионизационная ячейка для EFO-2000. Содержит 6 вольфрамовых ионизационных нитей. Напряжение 12 000 В.
4. **FF-2000** - Фильтр предварительной очистки для EFO-2000.
5. **IMP-2000** - Улавливатель масляного тумана лабиринтного типа для EFO-2000.
6. **EFO-3000** - Фильтр (макс. расход воздуха 2800 м³/ч) для очистки воздуха от масляного тумана. Содержит фильтр предварительной очистки, ионизационную и осадительную ячейки, а также приемную камеру с входным патрубком Ø 250 мм, дренажом и поддоном для сбора масла.
   EFO-3002/AL - Фильтр такой же, как EFO-3000, но с сигнализацией.
7. **EFO-5000** - Фильтр (макс. расход воздуха 4600 м³/ч) для очистки воздуха от масляного тумана. Содержит фильтр предварительной очистки, а также ионизационную и осадительную ячейки и приемную камеру с входным патрубком Ø 250 мм, дренажом и поддоном для сбора масла.
   EFO-5002/AL - Фильтр с сигнализацией. Когда потребуется очистка осадительной ячейки, загорается желт лампочка и включается звуковой сигнал. Через 12-15 сек вентилятор останавливается и загорается красная лампочка. Перед следующим включением фильтра его ячейки должны быть очищены.
8. **EC-3000** - Осадительная ячейка для EFO-3000 и EFO-5000. (Для EFO-5000 необходимы 2 такие ячейки). Содержит 83 осадительные пластины. Активная фильтрующая поверхность 16,4 м².
9. **IOO-3000** - Ионизационная ячейка для EFO-3000 и EFO-5000. (Для EFO-5000 необходимы 2 такие ячейки). Содержит 10 вольфрамовых ионизационных нитей. Напряжение 12 000 В.
10. **IMP-3000** - Улавливатель масляного тумана лабиринтного типа для EFO-3000 и EFO-5000.
11. **Вентиляторы** с трехфазным двигателем мощностью от 0,37 кВт, 380 В - 2,2 кВт, 380 В. Расход воздуха при работе без сети от 1300 м³/ч - 4700 м³/ч.

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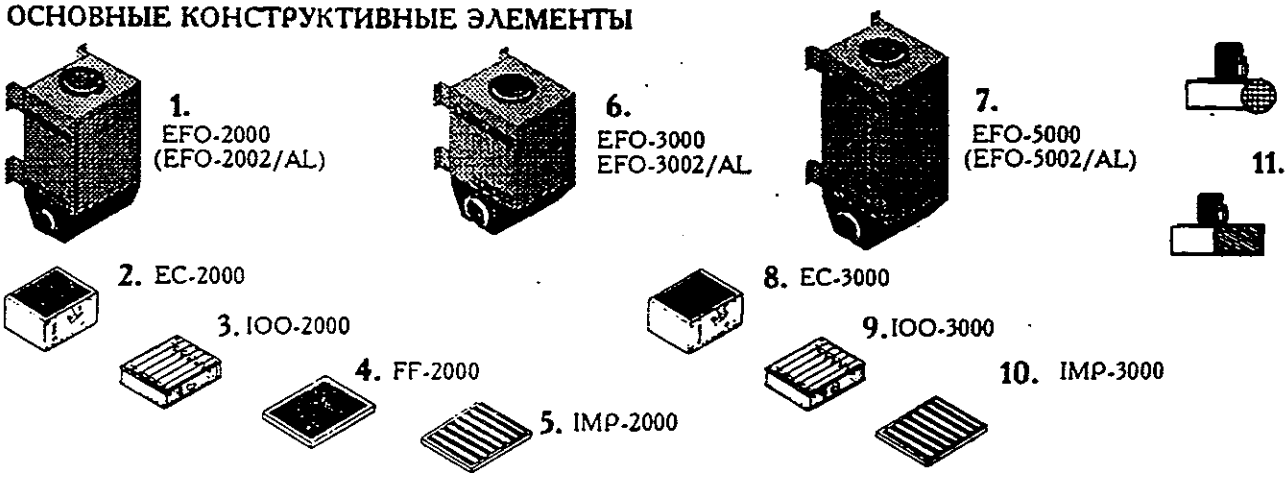

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