Pollution Prevention in Metal Parts Cleaning and Degreasing Operations

Resource Guide

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I. Pollution Prevention Overview

Evolution of the Pollution Control Approach

Awareness of Problems

Throughout the 1960s and 70s, public awareness of environmental problems escalated, through milestones such as Rachel Carson's *Silent Spring*, the burning Cuyahoga River, Love Canal, and Times Beach. These and many other events served to reveal the error of past actions and our overall ignorance of the effects of those actions on the environment. As awareness grew, Congress enacted legislation to address the pollution apparent in the environmental "media" of air, water, and land, as well as in the workplace.

Congressional Responses
creation of U.S.EPA

Congress also created the U.S. Environmental Protection Agency in 1970, and charged it with regulating and enforcing compliance with emerging environmental protection legislation. As regulations increased in number and complexity, the task of enforcing them also became (and continues to be) increasingly unwieldy and expensive.

legislation

The legislative response to pollution had two main traits. The first general characteristic of the legislation was that it set out to *control pollution.* The regulated community relied heavily on treatment and disposal to manage wastes, emissions or effluents *after they had been generated.*

Much of this legislation is *media-specific* in its approach. In other words, regulations governing pollution in water are separate from regulations governing pollution of land, which are separate from those regulating the workplace, and so on.

Milestone events due to past neglect, ignorance or accident, combined with rising public concern have spurred Congress to respond with new and tougher legislation. The Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act (RCRA), which addressed solid and hazardous wastes, all established control and management practices to take care of present and future pollution.

Through implementation of environmental laws, great strides have been made in protecting and restoring the environment. However, by promoting reductions in use of toxic chemicals, further progress

can be made to address the problems in the ecosystem and human health.

Community Right-to-Know

The Superfund Amendments and Reauthorization Act of 1986 extended the regulatory reach of CERCLA. Included in this omnibus bill was EPCRA, the Emergency Planning and Community Right-to-Know Act, which requires industrial or manufacturing facilities to notify local authorities of the presence of hazardous materials, and to make plans for emergencies due to accidental releases.

EPCRA provides considerable impetus for pollution prevention through its requirement that certain facilities using or manufacturing listed toxic materials in large quantities must report emissions of those materials on an annual basis to state and local authorities.

Toxics Release Inventory

These annual reports are compiled into the Toxics Release Inventory (TRI), which is widely publicized and readily available for public review. This powerful tool allows the public to examine information regarding these often-substantial legal releases on a facility-by-facility basis. In addition, the U.S. Pollution Prevention Act of 1990 requires that additional data be collected as part of TRI reporting.

The new "Form R", Section 8 of the TRI contains information on source reduction and recycling activities undertaken by reporting facilities, along with reductions achieved as a result of that activity. The form also requires reporting facilities to calculate a production ratio or activity index to normalize the reported quantities of chemicals to production rates. This will provide the public with a picture of where source reduction is taking place, and where it needs to be promoted and supported.

Source reduction is defined in the instructions for completing Form R as any practice which:

- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and
- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

The term source reduction is further clarified to define what is and is not included. Source reduction includes equipment or technology modifications,

process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

Implications

releases continue

Despite the the capture of many contaminants with pollution control technology and procedures, it is evident from TRI figures that large quantities of toxic materials are discharged into air, water and land every year, with untold effect. And these figures do not include emissions from far greater numbers of small businesses who are not required to report their releases.

pollution control shortfall

Certainly, the pollution control approach has reduced pollutant releases into the ecosystem. However, in order to achieve national environmental goals, it is necessary to complement the pollution control approach with prevention; reducing the use of toxic chemicals and the generation of hazardous waste at the source.

Drawbacks of the Pollution Control Approach

Examples of "Media Transfers"

air to land

Several classic examples illustrate how transfers between environmental media happen with pollution control technologies. At a facility, smokestack scrubbers remove and collect potentially toxic particulates to bring air emissions within regulatory standards. But these collected toxins must then be disposed of as landfilled hazardous wastes. This hazardous waste may leach from the disposal facility into ground or surface water, evaporate into the air, or remain in the ground or surface water.

air to water

Some booths for applying paints are equipped with water curtains, which capture solids and some solvents in overspray from paint guns. The water screen cuts down the number of spent air filters generated as hazardous waste, but it then requires treatment or recovery of metals and solvents from effluent water. A distinct possibility exists that treatment techniques will not be 100% successful, which means that some hazardous wastes will be discharged from the facility.

groundwater to air

In remediating groundwater contaminated by volatile solvents, it was (and still is) commonplace to pump contaminated groundwater from barrier wells to a holding vessel, where the volatiles are "stripped" from the water. This is essentially just allowing the

volatile to transfer to the air through evaporation. The volatiles go from drinking water, where they may become oral carcinogens, to the air, where they potentially become inhalation carcinogens, ozone depleting substances or smog precursors.

Problem: Media Transfers

In response to media-specific regulation, pollution control solutions address air pollutants, water discharges and management of hazardous wastes separately. As in the examples above, this results in a shift of pollutants and risks from one environmental medium to another. When pollution is prevented at the source it cannot be transferred to other environmental media

Problem: Control After Generation

Another drawback of treating or disposing of pollutants is that it deals with toxics after they have been used or generated.

risks of exposure

Addressing toxics after they have been used or generated leaves everyone vulnerable. Workers are susceptible to accidents and often unknown long-term exposure risks. Communities surrounding facilities may incur risks from long-term exposure to uncontrolled releases to air, surface water and ground water. Others in the path of supply routes or waste streams also may suffer if transportation accidents result in spills, or if waste treatment or containment facilities fail.

potential liability

Control after generation may increase the potential for future liability under any or all of the regulations addressing hazardous wastes, air, water, or workplace pollutants should company activities result in any public or environmental harm.

Problem: Short-term Solution

Controlling pollution after it has been generated is a short-term solution to a long-term problem. It may seem easiest to apply a technological control at the end of a process. In fact, some regulations may actually require installation of a specific device to bring the process into compliance.

long-term costs

The long-term costs of control of toxic releases-maintenance of control equipment, down time, insurance to cover worker health, hazardous waste, water effluent and air pollutant fees, potential liability for failures of treatment and disposal - are high and likely to continue to escalate. Toxic raw material inputs are similarly expensive, and indeed, future regulations may phase out their use entirely. From

an accounting standpoint, applying a control fix after the production process also tends to make costs of environmental protection harder to internalize as a true cost of production.

These factors make control more of a short-term approach, since a one-time capital investment does little to control long-term costs, does not address the cause of those long-term costs, and may actually require eventual process modification if the regulatory landscape changes.

Pollution Prevention

None of the pollution control options of treatment, incineration or disposal address long-term environmental problems as well as pollution prevention. Inevitably the environment will be overtaxed as emission and waste generation rates increase with economic activity. For these reasons, environmental agencies and others are attempting to promote the use of pollution prevention through regulatory programs in order to enhance environmental protection.

Going to the Source

Pollution prevention can extend environmental protection beyond what is possible with end of the pipe, post-process, pollution control. By going "up the pipe" and reducing the source of pollution- the use of toxic chemicals- the associated toxic or hazardous products, byproducts or wastes may be reduced or avoided. This approach offers greater, long-term protection of all environmental media. Pollution prevention can address the shortcomings of pollution control- shortcomings which include media transfers, increasing costs, and potential liabilities and risks of exposure.

The Process of Prevention

Pollution prevention is a perpetual examination of how toxic chemicals are used or produced. Understanding the reasons why, where and how they are used allows evaluation of opportunities for substitution or reduction of those uses. This represents a change in the approach to use and production and results from increased awareness of their total economic and environmental cost. Pollution prevention has potential for more effective and cost-efficient use of resources in business and industry, consumption of products and energy, agriculture, transportation, educational institutions and all other sectors of our economy.

Pollution Prevention Hierarchy

Pollution prevention can be thought of as a hierarchy of activities which are constantly applied to process of use, production or consumption of potentially toxic or hazardous materials. Prevention of wasted energy and water should also be considered in identifying opportunities in pollution prevention. The intent in applying this hierarchy is to always start at the top, looking for opportunities for prevention with the greatest potential impact on pollution.

Pollution prevention is best achieved through source reduction - reducing or eliminating the use of toxic or hazardous materials (including reductions of energy and water use)*at the source of use*, by

1. changing products;
2. substituting less hazardous materials;
3. using more efficient processes or equipment;
4. preventing inefficiencies due to lack of maintenance or poor housekeeping;
5. capturing or recovering materials for immediate reuse.

other options

Recycling (collection and transportation of materials for reprocessing) is a waste management option second only to pollution prevention. Recycling processes themselves have residual wastes that require disposal, and there are dangers associated with the transport and handling of the materials being recycled. And since recycling requires waste as a raw material, it can sometimes reduce incentives for source reduction of waste.

Recycling is not pollution prevention. A hierarchy of environmental management is described in EPA's Pollution Prevention Strategy of January 1991. At the top of this hierarchy is source reduction. Closed-loop recycling, which returns materials to the process directly without alteration, is preferable to out-of-process or off-site recycling. Closed-loop recycling is often included as part of pollution prevention.

When looking first to pollution prevention options, and implementing them, becomes protocol, pollution control technologies and procedures, incineration, treatment and disposal clearly become less preferable options.

Prevention in Business & Industry

implementation

If product and process modifications at the top of the source reduction hierarchy are not feasible, other options may have more immediate potential, primarily because they can more readily be applied

to existing processes. Modification of process and procedures, such as improved scheduling of production, improved housekeeping, attention to maintenance, employee training, on- and off-site recycling, all can take place at relatively low cost as part of a reorientation towards top-to-bottom environmental awareness and stewardship. New products and processes can have this stewardship built in, right from the design stage.

incentives for prevention

Companies stand to derive both tangible and intangible benefits from implementing pollution prevention. Financial benefits may include:

- avoided costs of transportation, treatment and disposal
- reduced or avoided costs of compliance (an industry could remove itself entirely from certain regulatory requirements, and avoid associated fees, fines)
- profit from sale of byproducts to others as raw materials
- savings on amount and costs of raw materials through closed-loop recycling
- reduced or avoided costs of litigation
- reduced or avoided insurance costs
- less down time due to occupational health problems
- avoided costs of addressing problems later, at inflated prices
- avoided costs of accidents and spills
- less down time due to lax maintenance
- materials costs reduced through thorough maintenance
- avoided costs of administration and management
- reduced cost of rejects

These are just some of the savings available. It is worth noting that many of these may never show up directly on the books, and could be difficult to track. But they should at least be assigned a value and taken into account when making decisions on implementing pollution prevention options.

public relations benefits

Another less direct benefit of pollution prevention is the development of "goodwill" with neighboring communities. Successful prevention efforts will allow industry to turn a traditional public relations liability into an asset. The industrial generator, usually seen as the "black hat" relative to environmental issues, can through a pollution prevention approach show that it is not only controlling its negative impact on the environment, but taking positive steps to prevent such impacts

from occurring in the first place. As the public's environmental awareness becomes more and more a part of the consumer decision making process, an manufacturer's reputation as an environmentally sensitive corporate citizen will have a directly positive impact on market share.

Definitions

The following terms are commonly used in discussions of pollution prevention and related topics. It is important to remember that with few exceptions, there are no standard definitions for these terms. Waste reduction/pollution prevention/ waste minimization initiatives were first codified by state and local governments while the debate over the definitions of these terms was at its height. As a result, the functional definitions of the terms and the activities associated with them vary from jurisdiction to jurisdiction. For a more complete discussion of this issue, please see Terry Foecke's article "Defining Pollution Prevention and Related Terms" included in this Chapter.

The definitions below are based on our judgement of the most accepted uses of the terms. We have used the accepted USEPA definition in cases where the Agency has established one.

Pollution Prevention: activities defined as "source reduction" under the U.S. Pollution Prevention Act of 1990 and other practices that reduce or eliminate the creation of pollutants through-

i) increased efficiency in the use of raw materials, energy, water or other resources, or
ii) protection of natural resources by conservation.

Pollution prevention includes equipment or technology modifications, process or procedure modifications, the reformulation or redesign or products, substitution of raw materials, and improvements in housekeeping, maintenance, training and inventory control.

Pollution prevention does not include recycling, energy recovery, treatment or disposal.

Some processes described as "in-process recycling" may qualify as pollution prevention.

(Taken from a memorandum dated May 28, 1992 by F. Henry Habicht II, Deputy Administrator of the USEPA, to all USEPA personnel.)

Source Reduction includes any practice which-

i) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the

environment (including fugitive emissions) prior to recycling, treatment, or disposal; and
ii) reduces the hazards t public health and the environment associated with the release of such substances, pollutants, or contaminants.

Source reduction includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

Source reduction does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service.

(Taken from the U.S. Pollution Prevention Act of 1990.)

Waste Minimization: activities that result in a reduction in waste volume as well as waste generation. *Waste minimization* includes all types of recycling (on- and off-site) and waste concentration as well as source reduction activities. This term usually refers to hazardous and toxic wastes.

Recycling: the collection, separation, recovery and sale or reuse of material that would otherwise be disposed of or processed as waste.

Waste Reduction: any activity which results in a net reduction in the amount of material that must ultimately be treated or disposed of or otherwise handled as waste product. *Waste reduction* includes all activities considered waste minimization, pollution prevention, or recycling.

U.S. Pollution Prevention Act of 1990

On October 27, 1990, the United States Congress passed the Pollution Prevention Act of 1990. This Act, signed by the President, formally recognized the prevention approach to environmental issues as the federally preferred means of dealing with waste generation and disposal. The Act represents a significant policy shift by the federal government away from post generation treatment toward viewing waste generation as part of, rather than the result of, a manufacturing process.

Pollution Prevention Hierarchy

The Act establishes a Pollution Prevention hierarchy as a national policy. This hierarchy states that it is U.S. policy that:

- pollution should be prevented of reduced at the source,
- pollution that cannot be prevented should be recycled in an environmentally safe manner,
- pollution that cannot be prevented or recycled should be treated in an environmentally safe manner,
- disposal or release to the environment should be used only as a last resort.

USEPA activities

The USEPA is directed through this Act to set up an office, independent of the single medium programs, to implement the Act. Specifically, this new office is mandated to:

- establish standard methods of measurement for source reduction,
- review regulations before and after proposal to determine their effect on source reduction,
- coordinate source reduction activities in each USEPA office and promote sour reduction practice in other Federal agencies,
- develop improved methods for providing public access to data collected under Federal environmental statutes,
- facilitate the adoption of source reduction techniques by businesses,
- identify measurable goals that reflect the policy of the Act, tasks to meet these goals, dates, required resources, organizational responsibilities, and means for measuring progress,
- establish an advisory panel of technical experts to advise the Administrator on ways to improve the collection and dissemination of data,

- establish a training program on source reduction opportunities,
- make recommendations to Congress to eliminate barriers to source reduction,
- identify opportunities to use Federal procurement to encourage source reduction,
- develop, test and disseminate model source reduction auditing procedures,
- establish an annual awards program.

grants

The Act establishes a Federal grants program designed to assist state programs promote source reduction by businesses. The Federal share of any project in this grants program is to be no more than 50%. This program is now known as the Pollution Prevention Incentives to the States (PPIS) program.

source reduction clearinghouse

The USEPA is directed through the Act to establish a Source Reduction clearinghouse containing information on management, technical and operational approaches to source reduction. This provision resulted in the establishment of the Pollution Prevention Information Clearinghouse (PPIC).

Form R

A pollution prevention and recycling activities reporting component is added to the TRI reporting requirements through this Act. On a facility wide basis, TRI reporters are required to report on the percentage change in the amount of chemical entering the waste streams, the quantities of chemical recycled, the change in the amount of chemical recycled, and any predictions regarding the changes in these levels in the future. Included in this reporting requirement is a discussion of the type of pollution prevention efforts made by the facility, the techniques used to identify pollution prevention opportunities, and information regarding changes in production levels.

The new Form R addition to TRI is designed to comply with this requirement.

State and Local Pollution Prevention Initiatives

States

Since 1987 twenty seven states have enacted legislation designed to promote pollution prevention as the preferred method of waste management. These pieces of legislation, many of which preceded the U.S. Toxic Pollution Prevention Act into law, are meant to formalize the shift in state environmental priorities from post generation solutions to procedures aimed at reducing the generation of waste at the source. This legislation represents a deepening commitment on the part of the states to foster the adoption of pollution prevention options in their generating communities.

RCRA and SARA focus

Most of these laws are directed at wastes defined under the U. S. Resource Conservation and Recovery Act (RCRA), or toxics defined in the U. S. Superfund Amendments and Reauthorization Act (SARA) and reported by facilities in accordance with SARA Title III, or both. Of the 27 states with legislation, all of them direct their activities at RCRA wastes while 17 of these acts extent the authority of the legislation to include SARA Title III releases and facilities. One state (Iowa) extends the list of included wastes to those governed under the Clean Air Act.

Source reduction is mandated as the most favored method of waste management in 25 out of the 27 pieces of legislation. An expressed multi-media focus of activities is called for in 21 of the state acts. Toxic materials use reduction is emphasized in ten states

two types of legislation

The action called for through this legislation varies greatly from state to state. Rather than going through all the various permutations, we have chosen two of the most recent bills that have been passed as examples. In many ways these acts represent the two most popular forms of this type of legislation.

Pollution Prevention Policy

At it's most basic level, state pollution prevention legislation establishes a new waste management hierarchy with source reduction or pollution prevention at the top, and sets up an office in the state environmental or public health agency which is to direct the state's pollution prevention activities. Often this legislation calls for the establishment of a technical assistance and/or grant program designed to

help generators develop and adopt pollution prevention options appropriate to their process or industry.

The state of Colorado enacted a bill of this in the spring of 1992. The Colorado legislation mandates the establishment of a Pollution Prevention Advisory Board. The Advisory Board, appointed by the Governor, is responsible for providing general policy guidance, developing reduction goals, and reviewing the regulatory structure to identify pollution prevention incentives and disincentives. The Advisory Board will also study and make determinations regarding the placement and activities of a state pollution prevention technical assistance program. The types of activities undertaken by this technical assistance program are enumerated in the legislative language. The Colorado legislation also establishes a coordinating agency in the Department of Public Health and a Pollution Prevention Fund. The Pollution Prevention Fund is designed to provide funding for the Colorado's pollution prevention activities by imposing a limited fee on facilities required to report under SARA Title III.

Pollution Prevention Planning

The other type of state pollution prevention legislation we will look at includes, in addition to mandates similar to those noted above, provisions that require certain generators to produce facility-wide pollution prevention plans. These plans are intended to assist waste generators analyze their waste streams with an eye toward isolating pollution prevention opportunities. Some states require that these plans include some sort of facility wide reduction target. A number of states (ME, MA, MS, NJ, NY, TN, VT, WA) actually establish a numeric state-wide waste reduction goal. Of the 19 states that mention facility planning in their pollution prevention legislation, 15 require these plans from certain classes of generators while, 4 make the preparation of such plans voluntary.

Pollution prevention facility planning is an important aspect of the recently enacted Amendments to the Arizona Hazardous Waste Management Statutes. Arizona's facility planning requirements are directed at facilities responsible for reporting waste generation to the Toxic Release Inventory. The facility-wide pollution prevention plan is to include:

- identification of the facility (name and address),
- the name of the senior official with management responsibility,

- a certification by upper management as to the accuracy of the plan,
- a statement of management policy,
- specific pollution prevention goals for the facility,
- statement of scope and objectives,
- pollution prevention opportunity analysis,
- statement of pollution prevention activities already in place,
- employee awareness and training programs,
- provisions to incorporate the plan into management practices,
- description of options considered and explanation for those not implemented.

This legislation also includes provisions that set up a technical assistance program. The provisions of this legislation are to be implemented with funds taken from the Hazardous Waste Management Fund which is also established as part of this act. Facilities that dispose of, store, or ship off site any hazardous wastes will be assessed fees that will contribute to the fund.

Again, legislatively mandated pollution prevention efforts vary widely from state to state. In order to fully understand the requirements of and the resources available through your state's pollution prevention legislation, it is important to review the appropriate legislation and seek any assistance you may need from the policy branch of your state's regulatory agency.

The following table will give you an idea of the pollution prevention legislation that has been enacted at the state level.

Municipalities

A significant number of city and county governments are experimenting with the inclusion of pollution prevention or waste reduction principles into local ordinances. Although not nearly as pervasive as pollution prevention efforts at the state level, many of these local efforts leverage the state efforts by bringing the message of pollution prevention to smaller generators and other sectors of the generating community not addressed by the larger state programs.

City and County Programs

Locally based pollution prevention efforts began in a handful of localities in the state of California. Communities ranging in size from the City of Los Angeles to the County of Nevada (a small mountain

county on the eastern edge of the state) began becoming involved in promoting pollution prevention in the late 1980s. The local pollution prevention movement has now spread to other areas of the country, being most popular in larger states, the west, and Great Lakes States.

program components

These local pollution prevention efforts, like state efforts, vary greatly from jurisdiction to jurisdiction. The types of services mandated by these local initiatives include:

- the establishment of interagency coordinating teams to reduce barriers to and facilitate the promotion of pollution prevention as the preferred method of waste management,
- providing information and technical assistance through on-site contact with industrial generators,
- waste assessments to be performed on city or county facilities,
- the establishment of a clearinghouse for pollution prevention information,
- the establishment of a newsletter with pollution prevention as its focus, and
- the sponsorship of workshops aimed at helping the generating community identify and implement pollution prevention options.

material bans

Some municipalities have taken their pollution prevention a step further by banning or phasing out the use of certain material within their jurisdiction. The major focus of these efforts have been the group of chemicals that contribute to the depletion of the earth's ozone layer. Some of these efforts will be further encouraged by certain provisions of the new U.S. Clean Air Act which requires cities and states to maintain their aggregate air quality below a certain level. By banning or restricting the use of some of these chemicals that substantially contribute to the level of air pollution present in their jurisdiction, many municipalities hope to comply with these new restrictions.

City of Irvine experience

The City of Irvine (CA), for example, passed an ordinance in August of 1989 that prohibits most uses of CFCs in manufacturing and cleaning operations as well as building insulation and foam packaging. The ordinance also requires the recovery and recycling of CFCs during the servicing of air conditioning and refrigeration equipment and halons in the servicing of fire suppression equipment. The use of CFCs in refrigeration equipment is not outlawed by this ordinance but its use is severely controlled.

The city estimates that there were between 150-200 facilities using CFCs in manufacturing and cleaning at the time the ordinance was passed. The city made substantial efforts to educate the public regarding the requirements of the ordinance. Much of this effort has revolved around educating concerned manufacturers about possible alternatives to the use of such chemicals.

Publicly Owned Treatment Works

A primary driving force behind many of these local efforts is the need for Publicly Owned Treatment Works (POTWs) to enforce federal and local waste discharge limits. The POTWs are facing mounting pressure that could seriously effect their ability to operate treatment plants efficiently and effectively in the near future, including:

- higher disposal costs necessitated by higher concentrations of toxic compounds in the sludges the POTW generates,
- increased illegal dumping of hazardous waste into waste streams headed for the POTW driven by the increasing regulation and expense involved in the disposal of such wastes,
- additional regulations further limiting the hazardous pollutants in POTW pass-through effluent, air emissions, and sludge, and
- future growth which will increase hazardous waste loads.

POTWs see pollution prevention efforts as a means to proactively address this situation.

Many efforts on the part of POTWs involve providing basic pollution prevention information to their client industries. POTWs may also provide technical assistance to local industry to help them identify and evaluate site-specific pollution prevention opportunities. Some POTWs have even attempted to develop regulatory requirements intended to promote pollution prevention.

Any effort by a POTW could have substantial benefit and/or impact hazardous waste generators in its vicinity. Individual interested in supporting an industrial generator's efforts in pollution prevention, particularly as those efforts relate to water use, should be sure to contact the POTW in their area to take advantage of any efforts they may be making in helping their clients reduce waste.

For more information

To find more information on local pollution prevention initiatives, contact the Department of Health in the city or county in which you are interested. It may also be necessary to contact the local Emergency Response Team, inspectors responsible for hazardous waste issues, or Fire Department to get a complete picture of the pollution prevention initiatives being taken in a particular municipality.

Resources

U.S. Pollution Prevention Act of 1990

Table of State Pollution Prevention Legislation

Terry Foecke,"Defining Pollution Prevention and Related Terms," *Pollution Prevention Review,* Winter 1991-92 pp.103-112

SECTION 1. SHORT TITLE AND TABLE OF CONTENTS.

This Act may be cited as the ``Pollution Prevention Act of 1990''.

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SEC. 2. FINDINGS AND POLICY.

(a) FINDINGS.--The Congress finds that:

(1) The United States of America annually produces millions of tons of pollution and spends tens of billions of dollars per year controlling this pollution.

(2) There are significant opportunities for industry to reduce or prevent pollution at the source through cost-effective changes in production, operation, and raw materials use. Such changes offer industry substantial savings in reduced raw material, pollution control, and liability costs as well as help protect the environment and reduce risks to worker health and safety.

(3) The opportunities for source reduction are often

not realized because existing regulations, and the industrial resources they require for compliance, focus upon treatment and disposal, rather than source reduction; existing regulations do not emphasize multi-media management of pollution; and businesses need information and technical assistance to overcome institutional barriers to the adoption of source reduction practices.

(4) Source reduction is fundamentally different and more desirable than waste management and pollution control. The Environmental Protection Agency needs to address the historical lack of attention to source reduction.

(5) As a first step in preventing pollution through source reduction, the Environmental Protection Agency must establish a source reduction program which collects and disseminates information, provides financial assistance to States, and implements the other activities provided for in this Act.

(b) POLICY.—The Congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an

environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

SEC. 3. DEFINITIONS.

For purposes of this Act--

(1) The term ``Administrator'' means the Administrator of the Environmental Protection Agency.

(2) The term ``Agency'' means the Environmental Protection Agency.

(3) The term ``toxic chemical'' means any substance on the list described in section 313(c) of the Superfund Amendments and Reauthorization Act of 1986.

(4) The term ``release'' has the same meaning as provided by section 329(8) of the Superfund Amendments and Reauthorization Act of 1986.

(5)(A) The term ``source reduction'' means any practice which--

(i) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and

(ii) reduces the hazards to public health and the environment associated with the release of such

substances, pollutants, or contaminants. The term includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

(B) The term ''source reduction'' does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service.

(6) The term ''multi-media'' means water, air, and land.

(7) The term ''SIC codes'' refers to the 2-digit code numbers used for classification of economic activity in the Standard Industrial Classification Manual.

SEC. 4. EPA ACTIVITIES.

(a) AUTHORITIES.—The Administrator shall establish in the Agency an office to carry out the functions of the Administrator under this Act. The office shall be independent of the Agency's single-medium program offices but shall have the authority to review and advise such offices on their activities to promote a multi-media approach to source

reduction. The office shall be under the direction of such officer of the Agency as the Administrator shall designate.

(b) FUNCTIONS.--The Administrator shall develop and implement a strategy to promote source reduction. As part of the strategy, the Administrator shall--

(1) establish standard methods of measurement of source reduction;

(2) ensure that the Agency considers the effect of its existing and proposed programs on source reduction efforts and shall review regulations of the Agency prior and subsequent to their proposal to determine their effect on source reduction;

(3) coordinate source reduction activities in each Agency Office and coordinate with appropriate offices to promote source reduction practices in other Federal agencies, and generic research and development on techniques and processes which have broad applicability;

(4) develop improved methods of coordinating, and assuring public access to data collected under Federal environmental statutes;

(5) facilitate the adoption of source reduction techniques by businesses. This strategy shall include the use of the Source Reduction Clearinghouse and State matching grants provided in this Act to foster the exchange of information regarding source reduction

techniques, the dissemination of such information to businesses, and the provision of technical assistance to businesses. The strategy shall also consider the capabilities of various businesses to make use of source reduction techniques;

(6) identify, where appropriate, measurable goals which reflect the policy of this Act, the tasks necessary to achieve the goals, dates at which the principal tasks are to be accomplished, required resources, organizational responsibilities, and the means by which progress in meeting the goals will be measured;

(7) establish an advisory panel of technical experts comprised of representatives from industry, the States, and public interest groups, to advise the Administrator on ways to improve collection and dissemination of data;

(8) establish a training program on multimedia source reduction opportunities, including workshops and guidance documents, for State and Federal permit issuance, enforcement, and inspection officials working within all agency program offices.

(9) identify and make recommendations to Congress to eliminate barriers to source reduction including the use of incentives and disincentives;

(10) identify opportunities to use Federal procurement to encourage source reduction;

(11) develop, test and disseminate model source reduction auditing procedures designed to highlight source reduction opportunities; and

(12) establish an annual award program to recognize a company or companies which operate outstanding or innovative source reduction programs.

SEC. 5. GRANTS TO STATES FOR STATE TECHNICAL ASSISTANCE PROGRAMS.

(a) GENERAL AUTHORITY.--The Administrator shall make matching grants to States for programs to promote the use of source reduction techniques by businesses.

(b) CRITERIA.--When evaluating the requests for grants under this section, the Administrator shall consider, among other things, whether the proposed State program would accomplish the following:

(1) Make specific technical assistance available to businesses seeking information about source reduction opportunities, including funding for experts to provide onsite technical advice to business seeking assistance and to assist in the development of source reduction plans.

(2) Target assistance to businesses for whom lack of information is an impediment to source reduction.

(3) Provide training in source reduction techniques. Such training may be provided through local engineering

schools or any other appropriate means.

(c) MATCHING FUNDS.--Federal funds used in any State program under this section shall provide no more than 50 per centum of the funds made available to a State in each year of that State's participation in the program.

(d) EFFECTIVENESS.--The Administrator shall establish appropriate means for measuring the effectiveness of the State grants made under this section in promoting the use of source reduction techniques by businesses.

(e) INFORMATION.--States receiving grants under this section shall make information generated under the grants available to the Administrator.

SEC. 6. SOURCE REDUCTION CLEARINGHOUSE.

(a) AUTHORITY.--The Administrator shall establish a Source Reduction Clearinghouse to compile information including a computer data base which contains information on management, technical, and operational approaches to source reduction. The Administrator shall use the clearinghouse to--

(1) serve as a center for source reduction technology transfer;

(2) mount active outreach and education programs by the States to further the adoption of source reduction technologies; and

(3) collect and compile information reported by States receiving grants under section 5 on the operation

and success of State source reduction programs.

(b) PUBLIC AVAILABILITY.--The Administrator shall make available to the public such information on source reduction as is gathered pursuant to this Act and such other pertinent information and analysis regarding source reduction as may be available to the Administrator. The data base shall permit entry and retrieval of information to any person.

SEC. 7. SOURCE REDUCTION AND RECYCLING DATA COLLECTION.

(a) REPORTING REQUIREMENTS.--Each owner or operator of a facility required to file an annual toxic chemical release form under section 313 of the Superfund Amendments and Reauthorization Act of 1986 (``SARA'') for any toxic chemical shall include with each such annual filing a toxic chemical source reduction and recycling report for the preceeding calendar year. The toxic chemical source reduction and recycling report shall cover each toxic chemical required to be reported in the annual toxic chemical release form filed by the owner or operator under section 313(c) of that Act. This section shall take effect with the annual report filed under section 313 for the first full calendar year beginning after the enactment of this Act.

(b) ITEMS INCLUDED IN REPORT.--The toxic chemical source reduction and recycling report required under subsection (a) shall set forth each of the following on a facility-by-facility basis for each toxic chemical:

(1) The quantity of the chemical entering any waste stream (or otherwise released into the environment) prior to recycling, treatment, or disposal during the calendar year for which the report is filed and the percentage change from the previous year. The quantity reported shall not include any amount reported under paragraph (7). When actual measurements of the quantity of a toxic chemical entering the waste streams are not readily available, reasonable estimates should be made based on best engineering judgment.

(2) The amount of the chemical from the facility which is recycled (at the facility or elsewhere) during such calendar year, the percentage change from the previous year, and the process of recycling used.

(3) The source reduction practices used with respect to that chemical during such year at the facility. Such practices shall be reported in accordance with the following categories unless the Administrator finds other categories to be more appropriate:

(A) Equipment, technology, process, or procedure modifications.

(B) Reformulation or redesign of products.

(C) Substitution of raw materials.

(D) Improvement in management, training, inventory control, materials handling, or other

general operational phases of industrial facilities.

(4) The amount expected to be reported under paragraph (1) and (2) for the two calendar years immediately following the calendar year for which the report is filed. Such amount shall be expressed as a percentage change from the amount reported in paragraphs (1) and (2).

(5) A ratio of production in the reporting year to production in the previous year. The ratio should be calculated to most closely reflect all activities involving the toxic chemical. In specific industrial classifications subject to this section, where a feedstock or some variable other than production is the primary influence on waste characteristics or volumes, the report may provide an index based on that primary variable for each toxic chemical. The Administrator is encouraged to develop production indexes to accommodate individual industries for use on a voluntary basis.

(6) The techniques which were used to identify source reduction opportunities. Techniques listed should include, but are not limited to, employee recommendations, external and internal audits, participative team management, and material balance audits. Each type of source reduction listed under paragraph (3) should be associated with the techniques or

multiples of techniques used to identify the source reduction technique.

(7) The amount of any toxic chemical released into the environment which resulted from a catastrophic event, remedial action, or other one-time event and is not associated with production processes during the reporting year.

(8) The amount of the chemical from the facility which is treated (at the facility or elsewhere) during such calendar year and the percentage change from the previous year.

For the first year of reporting under this subsection, comparison with the previous year is required only to the extent such information is available.

(c) SARA PROVISIONS.--The provisions of sections 322, 325(c), and 326 of the Superfund Amendments and Reauthorization Act of 1986 shall apply to the reporting requirements of this section in the same manner as to the reports required under section 313 of that Act. The Administrator may modify the form required for purposes of reporting information under section 313 of that Act to the extent he deems necessary to include the additional information required under this section.

(d) ADDITIONAL OPTIONAL INFORMATION.--Any person filing a report under this section for any year may include with the

report additional information regarding source reduction, recycling, and other pollution control techniques in earlier years.

(e) AVAILABILITY OF DATA.--Subject to section 322 of the Superfund Amendments and Reauthorization Act of 1986, the Administrator shall make data collected under this section publicly available in the same manner as the data collected under section 313 of the Superfund Amendments and Reauthorization Act of 1986.

SEC. 8. EPA REPORT.

(a) BIENNIAL REPORTS.--The Administrator shall provide Congress with a report within eighteen months after enactment of this Act and biennially thereafter, containing a detailed description of the actions taken to implement the strategy to promote source reduction developed under section 4(b) and of the results of such actions. The report shall include an assessment of the effectiveness of the clearinghouse and grant program established under this Act in promoting the goals of the strategy, and shall evaluate data gaps and data

duplication with respect to data collected under Federal environmental statutes.

(b) SUBSEQUENT REPORTS.--Each biennial report submitted under subsection (a) after the first report shall contain each of the following:

(1) An analysis of the data collected under section 7 on an industry-by-industry basis for not less than five SIC codes or other categories as the Administrator deems appropriate. The analysis shall begin with those SIC codes or other categories of facilities which generate the largest quantities of toxic chemical waste. The analysis shall include an evaluation of trends in source reduction by industry, firm size, production, or other useful means. Each such subsequent report shall cover five SIC codes or other categories which were not covered in a prior report until all SIC codes or other categories have been covered.

(2) An analysis of the usefulness and validity of the data collected under section 7 for measuring trends in source reduction and the adoption of source reduction by business.

(3) Identification of regulatory and nonregulatory barriers to source reduction, and of opportunities for using existing regulatory programs, and incentives and disincentives to promote and assist source reduction.

(4) Identification of industries and pollutants that require priority assistance in multi-media source reduction.

(5) Recommendations as to incentives needed to encourage investment and research and development in source reduction.

(6) Identification of opportunities and development of priorities for research and development in source reduction methods and techniques.

(7) An evaluation of the cost and technical feasibility, by industry and processes, of source reduction opportunities and current activities and an identification of any industries for which there are significant barriers to source reduction with an analysis of the basis of this identification.

(8) An evaluation of methods of coordinating, streamlining, and improving public access to data collected under Federal environmental statutes.

(9) An evaluation of data gaps and data duplication with respect to data collected under Federal environmental statutes.

In the report following the first biennial report provided for under this subsection, paragraphs (3) through (9) may be included at the discretion of the Administrator.

SEC. 9. SAVINGS PROVISIONS.

(a) Nothing in this Act shall be construed to modify or interfere with the implementation of title III of the Superfund Amendments and Reauthorization Act of 1986.

(b) Nothing contained in this Act shall be construed, interpreted or applied to supplant, displace, preempt or otherwise diminish the responsibilities and liabilities under other State or Federal law, whether statutory or common.

SEC. 10. AUTHORIZATION OF APPROPRIATIONS.

There is authorized to be appropriated to the Administrator $8,000,000 for each of the fiscal years 1991, 1992, and 1993 for functions carried out under this Act (other than State grants), and $8,000,000 for each of the fiscal years 1991, 1992, and 1993, for grant programs to States issued pursuant to section 5.

SURVEY OF STATE LEGISLATION

State/status	Definitions	Materials	Priorities	Coverage	Provisions	Access	Funding
Alaska enacted '90	Management: -solid & hazardous waste No statewide numeric goals		Includes: -source reduction -recycling -treatment -disposal Excludes: -incineration -media transfer	Not specified	-Technical assistance -Education -Grants -Information referral		Appropriations Not based on fees
Arizona enacted '91	Pollution Prevention -toxic use reduction -source reduction No statewide numeric goals	Hazardous & Toxic Waste	Includes: -toxic use reduction -source reduction -input, process, product change -"safe" treatment	Includes: -SARA reporters -large quantity generators	-Facility plans -Annual reports -Technical Assistance Program -Hazardous Waste Management Fund	Plans are confidential on request of owner.	Based on fees
California enacted '89	Reduction: -source -waste -release No statewide numeric goals	California hazardous & extremely hazardous wastes	Includes: -input, process, product change Excludes: -treatment -media transfer -volume change	Includes: -large-quantity generators Excludes: -those claiming infeasibility of options	-Facility plans -Performance reports -Pilot SIC codes -technical assistance	Plans/reports available to public; trade secrets available only to state	Based on fees and penalties
Colorado enacted '92	Pollution Prevention -any practice that reduces use or generation	SARA Title III & CERCLA	Includes: -input, process, product change Excludes: -recycling -treatment -disposal	All business and government. Focuses on small and medium-sized businesses	-Advisory Board -Pollution Prevention Fund -technical assistance		Based on fees
Connecticut enacted '91	Pollution Prevention: -generation -hazardous & toxic waste -multi-media No statewide numeric goals	Hazardous & Toxic Waste (not specified)	Includes: -input, process, product change Excludes: -incineration -media transfer -off-site or out of process recycle	Businesses with gross revenues of less than $25 M or less than 150 employees	-Technical assistance -Grant program		General Fund
Delaware enacted '90	Minimization: -hazardous & solid waste -multi-media reduction No statewide numeric goals	Delaware Code -solid/liquid/haz./refuse -air pollutants -sewage	Includes: -waste reduction -reuse & recycle -sound treatment & disposal	Industries & sites targeted at annual intervals Voluntary waste minimization planning	-Technical assistance -Information clearinghouse -Public education -Statewide recycling program	Trade secrets are protected	Not based on fees
Florida enacted '91	Pollution Prevention: -at the source No statewide numeric goals	Toxic and hazardous substances	Includes: -nonmandatory substitution & reduction (incl.energy) -product reform. -process change -procedure change -environ. planning -on-site recycling		-Technical assistance -Conferences	Proprietary information obtained through on-site technical assistance is confidential.	General Fund
Georgia enacted '90	Reduction: -haz. waste No statewide numeric goals	Georgia hazardous & acute hazardous waste	Includes: -input, process, product change in-house recycle Excludes: -treatment -media transfer -volume change -incineration	Includes: -large-quantity generators -out-of-state LQ generators using Georgia TSDs	-Technical assistance -Facility planning	Plans/reports available to public; trade secrets available only to state	Not based on fees

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SURVEY OF STATE LEGISLATION

State/status	Definitions	Materials	Priorities	Coverage	Provisions	Access	Funding
Illinois enacted '89	Prevention: -toxic pollution No statewide numeric goals	SARA toxic substances & Illinois lists	Includes: -input, process, product change in-house recycle Excludes: -treatment -media transfer -volume change -incineration	Voluntary & pilot (Cooperation on permits) -generators	-Technical assistance -Innovation -Inspectors' manual -Explore enforcement -Research (HWRIC)	Trade secrets protected	General fund and money raised by HWRIC activity
Indiana enacted '90	Prevention is reduction of: -toxic material use -waste release No statewide numeric goals	CERCLA hazardous substances & Indiana "environmental wastes"	Includes: -input, process, product change in-house recycle Excludes: -off-site recycle -media transfer -incineration	Voluntary & pilot	-Technical assistance -Research -Grants -Generator planning manual	Trade secrets protected	General fund
Iowa enacted '91	Prevention: toxics pollution No statewide numeric goals	Iowa lists which include SARA, RCRA	Includes: -input, process, product changes, integral recycle Excludes: -burning, transfer off-site recycle, exchange	Includes: -SARA reporters -LQGs	-Facility plans & summaries (voluntary) -Technical assistance -Information	Plans submitted to the Waste Management Authority for review and approval	General fund
Kentucky enacted '88	Reduction: -toxic waste generation No statewide numeric goals	RCRA, SARA	Includes: -input, process, product change in-house recycle Excludes: -off-site recycle or treatment -volume change	Voluntary: -RCRA and SARA report data collected	-Technical assistance -Information -Training -Grants -Set state goals	Trade secrets protected	General fund
Louisiana enacted '87	Reduction: -haz. & solid waste No statewide numeric goals	RCRA	Includes: -in-plant practices -in-process recycling Excludes: -off-process or off-site recycle -toxicity change	Includes: -large-quantity generators	-Waste reduction reports & plans (done) -Technical assistance -Fee structure promoting reduction	Public data laws apply	Based on fees & the general fund
Maine enacted '90	Reduction: -toxics use -toxics release -haz. waste Statewide goal-use reduction: -10% by 7/1/93 -20% by 7/1/95 -30% by 7/1/97	SARA toxics, RCRA	Includes: -input, product or process changes -capture for reuse, recycling treatment	Includes: -large-quantity generators -small-quantity generators -toxics users Excludes: -some LQGs, POTWs	-Facility plans and reports -Info program -Advisory committee -Technical services -Grants	Plans available to state	Based on fee
Massa-chusetts enacted '90	Reduction: -toxics use and/or release Statewide goal-waste reduction: -50%	SARA toxics, CERCLA	Includes: -input, product or process change Excludes: -incineration -media transfer -treatment -off-site recycle	Includes: -large-quantity toxics users -small-quantity toxics users Excludes: -facilities<10 employees	-Facility plans and reports -Toxics use planners -Toxics use survey -Technical assistance	Public petition for review of plan summary and report -plans are public; trade secrets protected	Based on fee

SURVEY OF STATE LEGISLATION

State/status	Definitions	Materials	Priorities	Coverage	Provisions	Access	Funding
Michigan enacted '87	Reduction: -any practice that reduces release or treatment	Hazardous, Solid, Liquid Industrial Waste and Air Contaminants	Includes: -input, product or process change -improved mgmt., training and/or inventory control.	Michigan businesses, governmental unit, and the general public	-Technical assistance	Information generated through grant programs is available to the public	Not based on fees
Minnesota enacted '90	Prevention: -toxic pollutants use, release generation No statewide numeric goals	SARA toxics	Includes: -input, product or process change -reduction in releases	Includes: -SARA reporters -large-quantity generators (fees only)	-Facility plans and reports -Guidance manual -Technical assistance -Grants	Public petition for review of progress reports -plans are protected	Based on fees
Mississippi enacted '90	Minimization: -haz. waste Statewide goal-waste reduction: -25% by 1/1/96	Any EPA-listed haz. waste	Hierarchy: 1. Source reduction 2. Waste reduc. 3. Recycling 4. Treatment 5. Disposal	Includes: -large-quantity generators -small-quantity toxics users -SARA reporters	-Facility plans and reports -Technical assistance -Training -Research -Explore new statutes	Plans may be made available to public; trade secrets are protected	Based on fees
Missouri proposed '91 (not passed)	Prevention: -source reduction Reduction: -hazardous waste generation No statewide numeric goals	SARA III 313 Missouri list	Prevention; -changes that result in a reduction Reduction: -input, process, product change, in-house recycle	Includes: -large-quantity generators -small-quantity toxics users -SARA reporters	-Facility plans and reports -Information -Conferences -Waste Audits -Low-interest loans -Waste exchange -Training	Plans and reports are available to the public; trade secrets are protected	Based on fees
New Jersey enacted '91	Prevention: -hazardous substance pollution Statewide goal-discharge reduction: -50% by 1996	SARA III 313 toxics	Includes: -input, process, product change, in-house recycle Excludes: -off-site recycle or treatment -incineration -increased poll. control	Priority facilities in selected SIC codes in 3 years. Others may be required by DEP	-Facility-wide permitting -Facility plans & summaries -Training	Trade secrets available to state, but not to public	Based on fines & general fund
New York enacted '90	Reduction: -haz. waste, toxic substance release & generation Statewide goal-waste reduction: -50% by 1999	SARA, RCRA	Includes: -input, process, product change, in-house, closed-loop or off-site recycling	Includes: -current permit holders -generators of 25 tons and up	-Facility plans & reports -Guidance manual -Evaluation	Public data rules apply	Based on fines & general fund
North Carolina enacted '89	Management & Minimization: -haz. waste No statewide numeric goals	RCRA & North Carolina	Includes: -minimization or reduction of quantity or toxicity of haz. waste	Includes: -all NC fee-paying generators	-Facility plans -Technical assistance -Grants -Information		Based on fees
Ohio proposed '91	Reduction: haz. waste Statewide goals to be established	RCRA solid & hazardous wastes	Waste Reduction: -source reduction (inputs, process, procedures) -on-site recycling -off-site recycling -treatment -sound disposal	Includes: -RCRA generators -out-of-state generators are subject to fees	-Technical assistance -Enforcement -Facility plans, notifications & annual reports	Reviewed by OHEPA; log of reviews done is public Trade secrets confidential	-Fees based on generation of hazardous & solid waste (may not pass) -Fines

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SURVEY OF STATE LEGISLATION

State/status	Definitions	Materials	Priorities	Coverage	Provisions	Access	Funding
Oregon enacted '90	Reduction: -toxics use -haz. waste generation No statewide numeric goals	SARA, RCRA	Includes: -input, process, product change, in-house, closed-loop or off-site recycling	Includes -SARA reporters generators: -conditionally exempt -fully-regulated -small-quantity	-Facility plans, reports & summaries -Technical assistance -Training -Information	Summaries are public record except trade secrets: plans & reports stay on-site	Based on fee
Pennsylvania rules published in 1992	Reduction: -reduction or elimination in generation of solid and haz. wastes No statewide numeric goals	RCRA, Pennsylvania residual wastes	Includes: -input, process, product change, in-house, closed-loop recycling	Includes: -haz. waste permittees -residual waste permittees	-Source reduction strategy	Strategies will remain confidential at the request of the generator	
Rhode Island enacted '89	Planning for: -haz. waste facilities No statewide numeric goals	RCRA, Rhode Island lists of "hard-to-dispose" materials		Includes: -all users of haz. waste facilities	-Technical assistance -Education -Research -Grants		Based on fee and general fund
South Carolina planned '91	Reduction: -toxics use -toxics generation Statewide goal-waste reduction: -50% by 1998	SARA, CERCLA, SC lists	Includes: -input, process, product change, in-house or closed-loop recycling Excludes: -incineration -treatment -off-site recycle -media transfer	Includes: -toxics users in selected SIC codes, small or large -POTWs Excludes: -under 10 FQE	-Facility plans, reports & summaries -Technical assistance -Outreach & training -Classify units of production	-Citizen petition -Trade secrets protected	Based on fee
Tennessee enacted '90	Reduction: -haz. waste -source Statewide goal-waste reduction: -25% by 6/3/95	RCRA	Includes: -in-process recycling or changes in process or inputs	Includes: -small-quantity generators -large-quantity generators	-Facility plans, reports & summaries -Technical assistance -Civil fines	-Summaries are public; plans & reports aren't	General fund
Texas enacted '91	Reduction: -source Minimization: -haz. waste No statewide numeric goals	SARA III 313 RCRA	Includes: -input, process, product change Excludes: -any process not integral to the product that alters the waste	Includes: -SARA reporters -Large-quantity generators	-Facility plans, reports & summaries -Governor's Award -Permit variance -Information -Conferences -Training -Waste Audits	-Summaries and reports are public; plans are not -Board can declare plan confidential	Based on fee
Vermont enacted '90	Management & Reduction: -source -toxics use Establish and adopt a statewide goal	SARA, RCRA	Includes: -input, process, product change, closed-loop recycling Excludes: -incineration -treatment -volume change -media transfer	Includes: -small-quantity generators -large-quantity generators -household generators	-Facility plans & reports -Study of toxic use reduction -Tax RCRA generators -Technical assistance -Research -Retail labeling	-Trade secrets are protected	Based on fee

SURVEY OF STATE LEGISLATION

State/status	Definitions	Materials	Priorities	Coverage	Provisions	Access	Funding
Virginia enacted '93	Prevention: -source -environmental waste	All wastes	Includes: -input, process, product change -closed-loop recycling Excludes: -treatment -incineration -out of process recycling -increased control	Includes: -small businesses -local governments	-Technical assistance -Waste exchange -Grants		General funds
Washington enacted '90	Reduction: -haz. waste -hazardous substance use Statewide goal-waste reduction: -50% by 1995	SARA, WA lists, Montreal Protocol (ozone-depleters)	Includes: -input, process, product change, closed-loop recycling Excludes: -incineration -media transfer	Includes: -all haz. waste generators regulated by WA -SARA reporters	-Facility plans & summaries (voluntary impl.) -Fees/penalties -Technical assistance -Research -Training	-Summaries & reports are public; plans are not -Competitive position protected	Based on fees
Wisconsin enacted '89	Use & Release Reduction: -toxic pollutants -haz. waste & substances Pollution Prev.. No statewide numeric goals	SARA, RCRA	Includes: -input, process, product change, closed-loop recycling Excludes: -incineration -treatment -out-of-process recycling -media transfer	Voluntary Includes: -haz. waste generators -hazardous substance users	Voluntary -Waste audits -Research -Grants Mandatory -Waste min. documentation on manifests & reports		General fund

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In the States

Defining Pollution Prevention and Related Terms

Terry Foecke

As the environmental movement has gained momentum over the past decade, dozens of new terms have emerged to describe various aspects of pollution prevention. In this article, we discuss the origins of some of these terms and how their use is evolving as the idea of pollution prevention moves into the spotlight.

POLLUTION PREVENTION. Waste reduction. Waste minimization. Source reduction. Sustainable development. Toxics use reduction. Low- and non-waste technology. Clean products. Green products. In less than a decade, these and other phrases have rapidly expanded the terminology associated with environmental protection.

The proliferation of terms also reflects the search for new and more sophisticated approaches to environmental management. Today, pollution control and pollution prevention have very distinct connotations. The consensus is that traditional pollution control methods simply transfer pollutants from one medium to another and therefore do not go far enough to protect all components of our environment. Pollution prevention, on the other hand, suggests an approach that goes to heart of the problem and tries to eliminate it.

Still, pollution prevention has many different interpretations. For example, in many cases, the definition of pollution prevention in one state may be markedly different from that in another state; definitions may even vary within a state. Both state and local pollution prevention programs run by public agencies, and legislation that mandates industrial pollution prevention, use their own terms. In addition, each term may have several definitions depending on the types of activities the state chooses to emphasize. This range of terms and definitions illustrates how new pollution prevention ideas are; there has been much experimentation, but little codification. This column gathers and categorizes the various definitions of pollution prevention included in legislation, as well as pollution prevention programs, at the state and local level.

Historical Perspective

State officials in North Carolina, who established one of the earliest formal state programs that specifically addressed what we now call pollution prevention, proved to be prescient in their name and breadth of focus. The first promotion and technical assistance program in North Carolina called itself the "Pollution Prevention Pays Program" (a slogan pioneered by the 3M Company) and resolved to consider all materials and by-products associated with industrial processes. This multimedia focus was seen at that time

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to be more common sense than it was representative of an overarching philosophy. A definition of pollution prevention was implicit in their approach.

Since North Carolina first used the term in 1984, the definition of pollution prevention has actually shifted from a broad, inclusive, intuitive beginning to a collection of fragmented, mutually exclusive definitions. It is only now returning to a definition that is broad in scope and application.

Waste minimization (which includes volume reduction, in addition to reduced generation) and *waste reduction* are related terms that constituted common vocabulary in state programs during the years 1986 to 1988. Waste reduction was used to describe activities that reduce the generation of waste. Some say that one reason this term became popular was that it lent itself to acronyms (WRAP, WRATT, WRITE, WRITAR, WREAFS, etc.).

. . . waste reduction began to be viewed by some people as a term used strictly to examine processes that generate industrial hazardous waste.

The terms are not interchangeable, however. The most important reason is that "waste" carries a specific definition under the Resource Conservation and Recovery Act (RCRA), and that definition can preclude, or seem to preclude, the use of the word waste in any phrase intended to cover materials other than hazardous waste as defined by RCRA. Thus, waste reduction began to be viewed by some people as a term used strictly to examine processes that generate industrial hazardous waste. Programs concerned with air releases, water discharges, or other toxics often found waste reduction too "exclusive" to describe or guide their efforts.

Source reduction has always had adherents as a descriptive phrase, mostly because of its implied focus on the point of generation, rather than the point of release to the environment. Source reduction, which has traditionally been used in programs that dealt with municipal and industrial recycling, began to see more use as a pollution prevention term in the late 1980s. It even generated a few acronyms of its own (SRRP, SRRTA, SRPA, etc.). However, source reduction has not adapted easily to broader usage. Specifically, the actual location of the source, intended to be the point of use or generation, has often been interpreted to mean an entire facility or group of activities that constitute a source of a release to the environment. This interpretation has its roots in regulations pertaining to air pollution control, which could limit its application to other media. As a result, source reduction is often used more often to clarify the definition of pollution prevention.

Toxics use reduction has gained considerable prominence over the past few years. This term refers specifically to *use* as a means to focus on the earliest point of possible generation or release. Its popularity can be attributed to at least two factors. First, the Toxics Release Inventory (TRI) required under Title III of the Superfund Amendment and Reauthorization Act (SARA) established a database to measure improvements in industrial environmental performance. This accounts, in large part, for the focus on toxics covered by any number of lists, and especially those substances included in the TRI. Second, many people are now as concerned about the potential exposure of workers to hazardous and toxic substances as they are about the health and safety of the public.

A groundswell of pollution pre-

vention legislation at the state level in 1989 and 1990, in many cases, incorporated the themes of toxics source and use reduction. Use reduction has been used as a descriptive phrase in some of that legislation as a way to eliminate the ambiguities described in the preceding paragraphs and to drive the focus of pollution prevention as close as possible to the source. Whatever its philosophical advantages, however, toxics use reduction is sometimes seen to be limited to certain classes of substances and activities.

Even though pollution prevention is now the descriptive phrase of choice, its definition is still open to considerable interpretation.

Throughout the late 1980s and early 1990s, other terms have floated in and out of usage. Low- and non-waste technology, clean technology, green business, and other phrases have been used in other countries, especially in Europe. None of these terms are able to span all economic sectors (e.g., industry and commerce, transportation, and energy), although such an approach is deemed by many to be critical to a comprehensive approach to environmental management. The most obvious problem is the failure to allow enough flexibility to consider all processes and decisions that may affect the environment.

Two responses to the demand for broader based concepts have been the phrases *sustainable development* and, in a return to the roots of the environmental movement, *pollution prevention*. Sustainable development is favored in international circles to promote the idea that economic growth does not have to be achieved at the expense of the environment. The specific message to industry: produce more with less.

Pollution prevention, however, is the term of choice in the United States. The U.S. Congress passed a Pollution Prevention Act in 1990, and the EPA has published a Pollution Prevention Policy Statement. The selection appears to be based on factors such as scope, ease of understanding, and wide applicability. Once again, pollution prevention has spawned a number of acronyms (PPIS, PPIC, PPPR, PPOA, and so on).

Difficulties of Application

Even though pollution prevention is now the descriptive phrase of choice, its definition is still open to considerable interpretation. One reason is the inclusion of many constituent parts (toxics use reduction, source reduction, waste minimization, and the like) to cover all human activities, decisions, and processes. Establishing a priority ranking or hierarchy has also opened pollution prevention to further definition. For example, is recycling preferable to, or part of, source reduction? If recycling is preferable, should it be on-site or off-site? If it is on-site, should it be closed-loop recycling or recycling that allows reuse in another on-site process?

Finally, the term pollution prevention still can be confused with pollution control. This confusion occurs because of the failure of the phrase pollution prevention to highlight the most significant philosophical difference between the two: Traditional pollution control focuses on discharges to a single environmental medium (i.e., air, water or land), but can result in the transfer of pollutants from one medium to another (the oft-mentioned "shell game" inherent to end-of-pipe management). Under pollution prevention, cross-media transfers are not acceptable.

Yet the distinction between pollution prevention and pollution control is not always clear. One way to differentiate the terms is through the use of the waste management hierarchy. Although some confusion is possible because of the mention of the word "waste," the hierarchy (shown below) is easy to understand. It is an especially useful tool for environmental decision making (moving from one area of process and use examination to another). Typically, the hierarchy flows from source reduction (at the top of the hierarchy) down through disposal. The rankings encourage a full exploration of each option, moving on only when all opportunities at a given level are exhausted.

SOURCE REDUCTION
REUSE
ON-SITE RECYCLING
OFF-SITE RECYCLING
TREATMENT
DISPOSAL

By beginning with source reduction, the hierarchy encourages the examination of basic assumptions about processes and use. By ending with treatment and disposal, the hierarchy also acknowledges that residuals are possible. However, the hierarchy is not a definition. It is simply a tool for individuals to use to make informed decisions. Terms such as "source reduction" and "recycling" are not defined in the hierarchy. Those who must deal with pollution prevention and related terms in the context of regulatory or legislative mandates, or who must choose the "best" option for any reason, must still define and use their own guidelines.

At the State and Local Level

This column has gathered definitions of pollution prevention and of components of pollution prevention (e.g., source reduction) from two sources: state and local pollution prevention programs, and state legislation that mandates pollution prevention activity.

Pollution prevention programs may use these definitions for internal goal-setting (e.g., choosing to allocate fewer resources to documenting treatment practices in favor of locating and documenting recycling opportunities or process modifications). Programs may also use definitions to carve out a niche that is separate from other activities within a parent agency or organization (e.g., a nonregulatory program based in a regulatory agency). In most instances, however, the definition only gives general guidance in initiative selection and program development.

Legislative definitions are more focused. In the case of mandates to write and implement facility plans for pollution prevention, the definition will determine the types of action a facility considers, what it may implement, and what matters when progress reports are written. In the case of regulatory requirements, definitions may guide the wording of notices of violation and enforcement settlements. However, even the most elaborate definitions require interpretation, often at a site-specific or process-specific level. This is a common problem in all types of legislation and is no less difficult when it comes to pollution prevention.

Program definitions

Among pollution prevention programs run by public agencies, there

is a broad range in definitions. Some programs see no need to state explicit definitions; others have definitions that are longer than those found in any legislation. These fall into four rough categories. Minimal or no definitions are used by a minority of programs, primarily older programs that began operations before definitions were much of an issue and programs with a nonregulatory focus. An example of this group is the Pollution Prevention Pays Program in North Carolina, which in response to a survey stated: "Specific, limiting definitions are not a problem in our program since we are not involved directly with regulatory efforts."

Some programs define only pollution prevention and define that term in such a way that source reduction is clearly preferred. Programs that favor toxics reduction or use reduction are included in this group. Few programs define pollution prevention in the very broad terms described earlier. One example of a definition that strives to be all-encompassing comes from the Pollution Prevention Program in Los Angeles County (California):

> Pollution prevention is the prevention of the generation of wastes from industrial, commercial and residential activities, including the avoidance of crossmedia transfer of pollutants. The waste can be hazardous or non-hazardous, solid, liquid or gaseous, and the means could include waste reduction, source reduction, recycling, clean product development and cultural and habit change or reformulation, industrial process modification, improved efficiency and management practices, etc.

Another category of programs has definition lists that encompass a large number of terms, usually including pollution prevention, waste reduction, waste minimization, source reduction, and recycling. This is by far the largest category (thirty-eight of seventy-four programs surveyed). There is a wide range in the degree of language specificity and the interconnection between terms. Many of the detailed "definition lists" do not express a preference for a particular term. Some are drawn from legislation passed in that state, and some make reference to federal legislation and policy statements. An example of a definition list is provided by the Bureau of Pollution Prevention in New York:

> *Pollution prevention* is the reduction in volume of solid waste, reduction in volume and/or toxicity of hazardous waste and/or toxic substances, including source reduction and recycling.
>
> *Waste reduction* is the reduction in volume of solid waste, reduction in volume and/or toxicity of hazardous waste, and is directed at solid waste media.
>
> *Waste minimization* is the same as waste reduction except that treatment to reduce or detoxify generated waste is included under waste minimization.
>
> *Source reduction* is the in-plant practices used to reduce, avoid, or eliminate the generation of waste, including input substitution, technology modification, good housekeeping practices and product reformulation.
>
> *Recycling* is the direct use or reuse (that which is not closed-

> loop) of waste material in a process or reclamation by recovering secondary materials for separate end use or by removing impurities so that waste may be reused.

A final category covers those programs that define a few chosen terms, where others are not applicable or simply not commonly used by program officials or their clients. This is a fairly large group (twenty of seventy-four programs). This is also the most difficult list to categorize because of the variety of definitions and the reasons given for making those choices. Several examples will illustrate this diversity.

The Maine Office of Pollution Prevention goes to the heart of the definition controversy and defines two components only, pollution prevention and recycling, as follows:

> Pollution prevention is the use of processes, practices or products that reduce or eliminate the generation of pollutants and wastes or that protect natural resources through conservation or more efficient use.
> Recycling is the collection, separation, recovery, and sale or reuse of material that would otherwise be disposed of or processed as waste, or mechanized separation and treatment of waste, other than through combustion, and the creation and recovery of reuseable materials other than as fuel for the generation of electricity.

The Iowa Waste Reduction Center only uses a definition to award the annual Governor's Waste Reduction Award. The Center therefore chooses to define only waste reduction, but in a way that gives that term broad coverage:

> *Waste reduction* is the reduction in volume and/or toxicity of waste at the source, or reuse as a raw material in a production process. Reduction measures include process modifications, raw material substitutions, housekeeping/management practices, recycling within a process, or any other measure that reduces the volume/toxicity of waste exiting a process or requiring treatment, or reuses waste as a raw material in production of goods or services.

A final example is from the City of Berkeley, California, Toxics Program, which uses the shortest definition of any of the programs:

> *Source reduction* is any action that causes a net reduction in the generation of hazardous waste.

Table 1 shows the pollution prevention programs surveyed, grouped by the categories described above.

Legislative definitions

The twenty-three state laws examined for this column yielded no fewer than ten discrete, but related, approaches to the problem of defining pollution prevention. Careful reading of the provisions of each definition, however, reveals that many share some basic characteristics. On the issue of "allowable" recycling, for example, seventeen of the laws explicitly exclude recycling activities that occur either away from the facility or away from the generating process. Treatment or incineration or both are excluded from the definition in fourteen laws. Fourteen laws also include the dynamic "is/is not" to further clarify the definition. Legislation passed by the state of Iowa includes all these themes:

Table 1. State and Local Pollution Prevention Programs Grouped by Definition Category

Minimal Definition of Pollution Prevention

Waste Reduction Assistance Program, Alaska Health Project (AK)
Pollution Prevention Office (AK)
Project ROSE (Recycled Oil Saves Energy) (AL)
Center for Training, Research and Education for Environmental Occupations (FL)
Illinois Environmental Protection Agency (IL)
The Hazardous Waste Research and Information Center (IL)
Kansas State University RITTA Program (KS)
Minnesota Pollution Control Agency (MN)
EPA Center for Waste Minimization and Management (NC)
Pollution Prevention Pays Program (NC)
WasteCap (NH)
University Center for Environmental and Hazardous Materials Studies (VA)
Pollution Prevention Division (VT)
Vermont Waste Cap (VT)

Pollution Prevention Only Defined Term

City of Berkeley Toxics Program (CA)
Connecticut Department of Environmental Protection (CT)
Toxic Use Reduction Act Implementation Team (MA)
Minnesota Office of Waste Management (MN)
Minnesota Technical Assistance Program (MN)

Definition List

Hazardous Material Management and Resource Recovery (AL)
Biomass Resource Recovery Program (AR)
Hazardous and Toxic Materials Office, City of Los Angeles (CA)
Pollution Prevention Program, San Diego (CA)
Chief Administrative Officer's Hazardous Waste Management Program, San Francisco (CA)
Connecticut Technical Assistance Program (CT)
Florida Waste Reduction Assistance Program (FL)
Pollution Prevention Program, Hazardous Waste Technical Assistance Program (GA)
Landfill Alternative Grants (IA)
Comprehensive Solid Waste Management Planning (IA)
Waste Reduction Assistance Program (IA)
The Indiana Pollution Prevention Program (IN)

Table 1. (continued) State and Local Pollution Prevention Programs Grouped by Definition Category

Definition List

Indiana Point-Source Pollution Prevention Program for Agricultural Industries (IN)
Kentucky Partners, State Waste Reduction Center (KY)
Waste Minimization Assessment Center (KY)
Toxics Use Reduction Institute (MA)
Waste Reduction and Management Program (MI)
Mississippi Technical Assistance Program, Mississippi Solid Waste Reduction Assistance Program (MS)
North Carolina Pollution Prevention Pays Program (NC)
New Hampshire Pollution Prevention Program (NH)
Municipal Water Pollution Prevention Program (NM)
Solid Waste Bureau (NM)
Bureau of Pollution Prevention (NY)
Erie County Office of Pollution Prevention (NY)

Selected Terms Defined

Pollution Prevention Program, Los Angeles County (CA)
Pollution and Hazardous Waste Reduction Program, Bay Area (CA)
Pollution Prevention and Waste Reduction Program (CO)
Delaware Pollution Prevention Program (DE)
Florida Center for Solid and Hazardous Waste Management (FL)
Iowa Waste Reduction Center (IA)
Indiana Pollution Prevention Program Office (IN)
Office of Pollution Prevention (ME)
Office of Waste Reduction Services (MI)
Waste Management Program (MO)
Hazardous Waste Section (NE)
New Jersey Office of Pollution Prevention (NJ)
New Jersey Technical Assistance Program for Industrial Pollution Prevention (NJ)
Business Environmental Program (NV)
Technical Advisory Services Division, New York State Environmental Facilities Corp. (NY)
Source Reduction Program (NY)
Toxics Reduction,Waste Reduction, Recycling and Litter Control Program (OR)
Division of Waste Minimization and Planning (PA)
Wisconsin Department of Natural Resources (WI)

Toxics pollution prevention: employment of practices or techniques that reduce industrial use of toxic substances or the hazards associated with an environmental waste, excluding any practice applied to environmental waste after generation (including dilution or concentration). It includes:

1. **Input substitution**
2. **Product reformulation**
3. **Production process redesign or modification**
4. **Production process modernization**
5. **Improved operation and maintenance, including**
   - **-improved housekeeping**
   - **-system adjustments**
   - **-product or process inspection**
   - **-production process control equipment and methods**
6. **Recycling, reuse, or extended use integral to the production process**

It does not include:

1. **Burning of waste to recover energy**
2. **Transfer of waste between environmental or workplace media, or into a product**
3. **Off-site recycling**
4. **Waste exchange**
5. **Incorporating or embedding regulated environmental wastes into products or by-products**
6. **Any other end-of-pipe management**

Some state legislative definitions do use open-ended language, leading to broader applications. For example, legislation in Ohio and Alaska defines a priority list of waste management actions that generators may employ. That noted, however, none of the state legislation has attempted the conceptual definitions and intertwining of terms used by many of the pollution prevention programs, probably because of stricter legal requirements applied to definitions that are to be included in legislation. **Table 2** categorizes legislative definitions according to the primary term used in the law. The reader should keep in mind, however, that there are more similarities between these seemingly disparate terms than are readily apparent.

Table 2. State Legislative Definitions Grouped by Primary Term

Primary Definition Term	*States Using*
Hazardous waste reduction	Kentucky, Ohio
Waste/source reduction	Alaska, Tennessee
Source reduction	California, Minnesota, Vermont
Pollution prevention	Connecticut, Florida, Indiana, New Jersey
Waste minimization	Delaware, Mississippi
Waste reduction	Georgia, Louisiana
Toxic pollution prevention	Illinois, Iowa
Toxics use reduction	Maine, Massachusetts, Oregon, South Carolina
No specific term defined	Rhode Island, Washington

In Conclusion

As implementation of pollution prevention programs continues and legislative mandates evolve, a clear definition should emerge from these discussions and experiments. At this time, it is important to remember that pollution prevention is a concept—a way of thinking about a number of environmental issues. Like any concept, its definition is clearest when it is put in the context of a specific application and less clear when it is presented in the abstract.

Still, considerable variation remains: "Waste reduction" in one state may mean "source reduction" in another. Nevertheless, disparities are diminishing, and some clear lines are being drawn, especially in the areas of treatment and recycling.◆

II. An Overview of Cleaning and Degreasing Processes

Parts cleaning and degreasing is an important aspect of any metal finishing or assembly operation. At any number of stages in the manufacturing process, parts may require cleaning in order to allow them to be inspected, prepare them to receive paint or other surface coatings, or go through an assembly process in which the presence of dirt or oils would detract from the quality of the final product.

Assembly components are not the only items that require cleaning in an industrial setting. Hand tools, work surfaces, and other assembly equipment may also need cleaning in order to prevent cross contamination from between batches or to keep it in good working order.

Cleaning and Degreasing

the universal solvent

Water is usually the first consideration when choosing a cleaning medium. Water is inexpensive, non-toxic and readily available, making it an attractive solvent. And with the addition of detergents, water works well in breaking down and removing a number of soils.

But there are certain properties of water that prevent it from being used in all cleaning applications. Among these properties are:

- •low solubility for many organic soils,
- •a slow drying rate,
- •good conductor of electricity,
- •a high surface tension, and
- •a propensity for rusting ferrous metals and staining non-ferrous metals.

In instances where water is not a satisfactory cleaning medium because of these limitations, organic solvents have become the standard cleaning medium.

Organic solvents

The organic solvents which have been used to replace water based detergents include:

- •ester solvents,
- •chlorinated solvents,
- •fluorinated solvents,
- •aliphatic solvents,
- •aromatic solvents,
- •ketones, and
- •alcohols.

These solvents are derived principally from petroleum and can be used alone or in blends. Organic solvents have become widely used by industry because they effectively clean soils that

water based detergents cannot and have short drying times which allow parts to move through the assembly process quickly.

degreasing

One of the most attractive attributes of organic solvents in cleaning applications is their ability to thoroughly remove grease, fats, oils, waxes and other difficult substances. Often these substances hold other insoluble matter like sand, metal chips, etc., and they must be broken down in order for this matter to be washed away.

Organic solvents have become very important in cleaning all types of metal parts because of their degreasing ability. Most metal parts come in regular contact with some type of oil as the part is machined or stored. Machining fluids and rust inhibiting oils must be removed at various points in the manufacturing process. Organic solvents do this very effectively. This degreasing ability also makes these solvents ideal for equipment maintenance and cleaning applications.

A table of the most commonly used organic solvents is included in the Resources of this Module.

Cleaning considerations

The variety of organic solvents available requires careful analysis of the cleaning needs in order to maximize solvent life and efficacy. Some organic solvents react with the substrate of the part or equipment being cleaned, thereby damaging the surface. Other solvent cleaning systems have difficulty cleaning "blind holes" (areas of the part or equipment which are hard to access). Still others remove some soils quite well and other soils not at all.

The following factors must be considered when choosing a cleaning medium:

- type of soil to be removed,
- amount of soil to be removed,
- degree of cleanliness required,
- properties of the substrate to be cleaned,
- size, shape and complexity of the part to be cleaned,
- volume or number of parts to be cleaned,
- cost of raw materials, and
- worker protection.

Solvent cleaning systems

Often parts cleaning in an industrial setting requires a number of cleaning steps depending on the type of soils to be removed. These steps can involve any of the usual solvent cleaning systems and the organic solvents appropriate to those systems.

The three most common cleaning systems are cold cleaning, open-top vapor degreasing and conveyorized degreasing. All types of solvents are used in cold cleaning operations while degreasing operations usually use only halogenated solvents (those containing chlorine and/or fluorine) because they are not flammable and their vapors are much heavier than air.

cold cleaning

There are four basic cold cleaning processes:

- •wipe cleaning- soaking a clean rag with solvent or cleaning solution and then wiping the part clean (usually used in maintenance operations).
- •soak or dip tank cleaning- soaking parts in a tank of cold solvent or cleaning solution. Heat may be introduced into the system in order to increase the cleaning efficiency of the solvent. Ultrasonic units may also be added to the system to produce small bubbles (through cavitation) which creates a vigorous scrubbing action throughout the solution.
- •diphase cleaning- parts are given a water rinse before and after solvent cleaning step. This type of cleaning is often done in a single tank, relying on the relative insolubility of halogenated solvents and water to keep the fluids segregated in the tank.
- •steam gun stripping- a combination of non-halogenated solvents and steam are used to strip paint from a metal surface.

open top vapor degreasing

All vapor degreasing operations rely on hot solvent vapor condensing directly on cold parts, dissolving the soils present and being rinsed away. The dirty solvent falls back into the tank, is reheated and vaporized, leaving the contamination behind.

Open top vapor degreasing systems (Figure 1)are batch loaded, cleaning only one load at a time. The halogenated solvent in the bottom of the tank is heated to boiling and the solvent vapor is trapped in the tank by a set of condenser coils located on the side walls of the degreaser tank below the top edge. The condensing action of the coils is often supplemented by a water jacket which also prevents convection of solvent vapors up hot degreaser walls. The area between the liquid solvent and the condensor coils where the pure solvent vapor is contained is the area in which the cleaning action takes place. Although dirty solvents are returned to the liquid bath of the degreaser, the contaminants are not allowed to vaporize when the solvent is reheated. Parts are always exposed to pure solvent vapor.

A significant amount of space is left above the condenser coils (referred to as "freeboard") to protect the solvent vapor zone from disturbance caused by air movement around the equipment. Freeboard is usually 50-60% of the width of the degreaser for solvents with higher boiling points and 75% of the degreaser width for solvents with lower boiling points. Higher than recommended freeboards reduce solvent emissions better than the standard freeboard configurations.

Many open top degreasers are also equipped with lip exhaust systems to capture escaping solvent vapors and carry the emissions away from the work area. Some degreasers also come equipped with spray lances (Figure 2)that allow for direct application of solvent to particularly soiled parts or equipment. Although these spray lances do facilitate cleaning some type of parts, they are the cause of a great deal of lost solvent when they are improperly used.

conveyorized cleaning

Rather than cleaning parts one batch at a time, conveyorized degreasing systems process parts in a continuous fashion in a hooded or covered assembly. Figures 3 and 4 represent two different configurations of conveyorized vapor degreasers. The parts are placed in baskets, pans, or otherwise attached to a circular or linear transport system which moves them through the cleaning process. Because they are designed to handle large volumes of parts, these cleaning systems are most often found in manufacturing plants where there is enough production to provide a constant stream of components to be cleaned.

Conveyorized degreasing operations use both cold and vaporized solvents. As with all organic solvent cleaning processes, the type of solvent used in these systems is determined by the type of part being cleaned, the soils to be removed, and the design of the cleaning system itself. The parts are cleaned by immersing them in liquid solvent, spraying them with a solvent mist, or passing them through a solvent vapor zone.

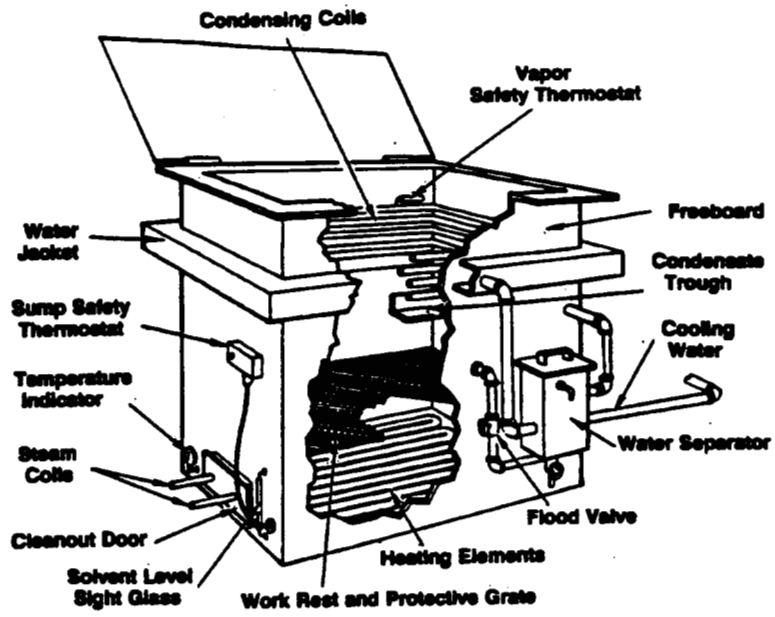

Figure 1 Typical open-top degreaser
(Dow Chemical, no date)

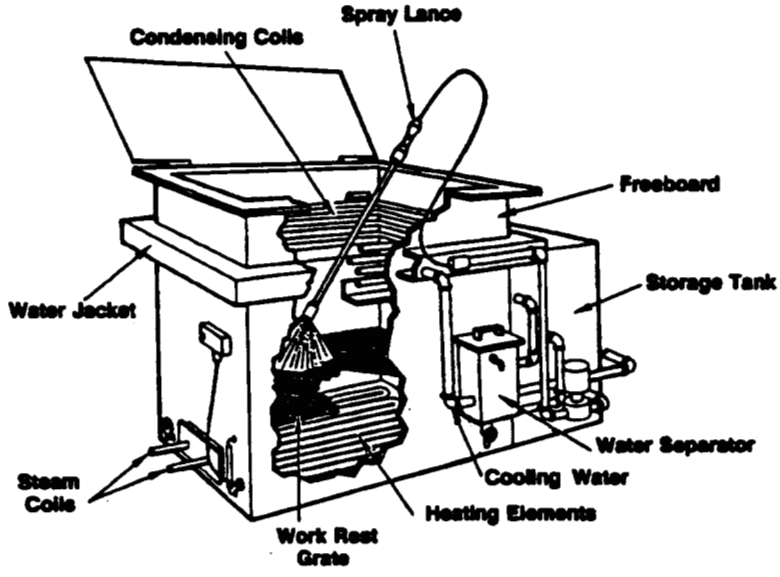

Figure 2 Vapor Degreaser with spray lance
(Dow Chemical, no date)

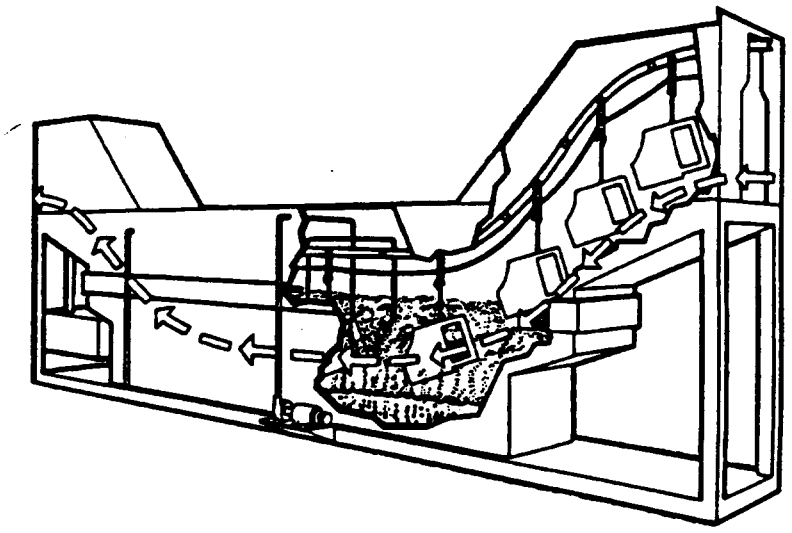

Figure 3 Monorail coveyorized degreaser
(Dow Chemical, no date)

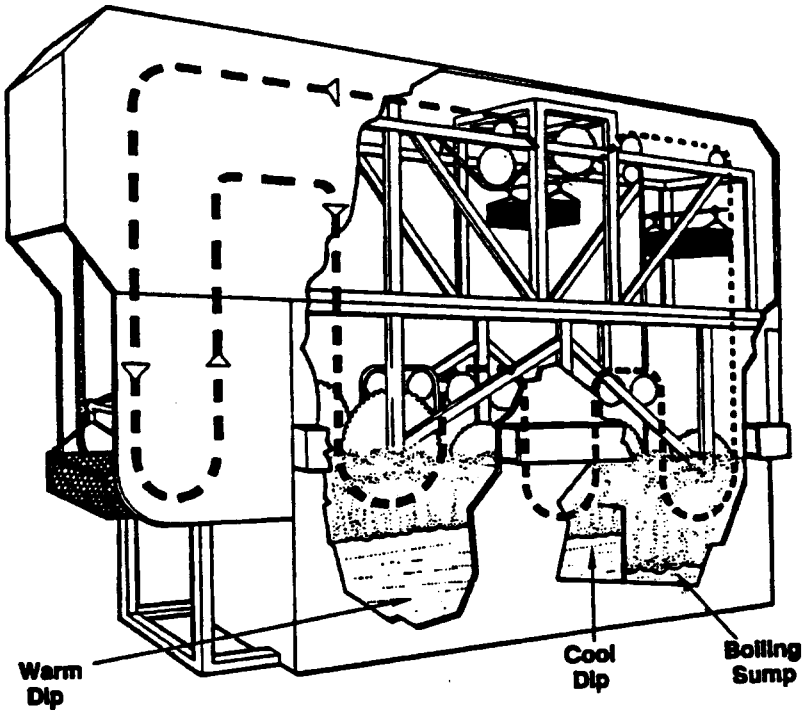

Figure 4 Cross-rod conveyorized degreaser used for small parts
(Dow Chemical, no date)

Montreal Protocol and U.S. Clean Air Act Amendments Phase-out Schedules

Montreal Protocol

In the Fall of 1987, 24 countries and the European Economic Community met in Montreal, Canada to address the threat to the ecosystem posed by ozone depleting chemicals. On September 16 of that year, these nations signed an agreement designed to address this threat.

The Montreal Protocol on Substances that Deplete the Ozone Layer and subsequent 1990 amendments and adjustments, was eventually agreed to by a total of 60 countries. The Protocol addresses the use and manufacture of ozone depleting chemicals in general, and calls for the phase-out of two such chemicals commonly used in cleaning and degreasing operations. These two chemicals, CFC-113 (chlorofluorocarbon 1,1,2 trichloro-1,2,2 trifluoroethane) and 1,1,1 trichloroethane (otherwise known as TCA, methyl chloroform, or MCF) are scheduled to be completely phased out in developed countries by the years 2000 and 2005 respectively and ten years later in developing countries. The phase out schedules for both substances are shown on Overheads 1 and 2 in the following set.

In addition to calling for a phase-out in in the use and manufacture of these two ozone depleting substances, the Montreal Protocol also contains provisions that restrict the trade in these substances between participating and non-participating countries. These provisions are designed to allow participating countries to proceed with the phase out of the substances without being put at an extreme competitive disadvantage. The Protocol also contains provisions that prohibit participating countries from encouraging the manufacture of these substances in countries that have not signed the agreement. These provisions are intended to prevent signatories from exporting their pollution problems to non-participating countries.

U.S Clean Air Act Amendments

In the amendments to the U.S. Clean Air Act that were ratified in 1990, there are several provisions that deal with statospheric ozone protection.

The Clean Air Act Amendments contain a more aggressive phase-out schedule for CFC-113 and TCA than those contained in the Montreal Protocol. The Clean Air Act Amendments accelerate the phase-out of these chemicals in the early years of the

schedule in order to maximize early (and presumably easily achieved) reductions. Both call for the final phase-out of CFC-113 and TCA in the year 2000 and 2005 respectively. Overheads 3 and 4 show the Clean Air Act Amendments phase-out schedules.

excise taxes

Probably the most significant difference between the phase out of ozone depleting chemicals under the Montreal Protocol and the Clean Air Act Amendments for US firms is the imposition of excise taxes under the Clean Air Act Amendments. This tax has already begun being applied to the manufacture or import for use of CFC-113 and TCA. The tax is intended to provide further incentive for companies to limit or eliminate the use of these substances.

The excise taxes on chlorinated solvents began in 1990 and progressed along the following schedule:

	Tax amount per kilogram	
Year	CFC-113	TCA
1990	$2.416	no tax
1991	$2.416	$0.302
1992	$2.945	$0.368
1993	$4.674	$0.661
1994	$4.674	$0.683

This tax will increase each year after 1994 by $0.794 kg for CFC-113 and $0.099 for TCA.

Discussion

The mandated phase out in the use of these two chlorinated solvents popular in cleaning and degreasing operations provides a very strong incentive for firms using those solvents in cleaning to look for alternative solvents or cleaning methods. It may be the case than in any given audience of manufacturers, the impending phase out in the availability of CFC-113 has already moved a significant number of them to replace this solvent with another in their vapor degreasers. In fact, when the CFC phase out was announced, many solvents suppliers and consultants advocated switching from CFC-113 to TCA for vapor degreasing because they are fairly comparable in those operations.

Switching from one chlorinated solvent to another that is less regulated does make a certain amount of business sense for small business operators who have invested in a vapor degreaser. These pieces of equipment are expensive and small businessmen will be hard pressed to decommission equipment in which they have made a significant capital investment. This is significant in that it is often difficult and time consuming to test and implement a

change away from chlorinated solvents in vapor degreasing. The easy move here is to move down the regulatory hierarchy.

The most important point to be made here is that people whose business it is to know these things (corporate environmental managers and trade association representatives) believe that switching from CFC-113 or TCA to another chlorinated solvent is simply postponing the inevitable. David Burch of the National Screw Machine Products Association puts it this way:

> "The bottom line, from where I sit, is that there is just no future in chlorinated solvents for parts cleaning. Freon (CFC-113) and methyl chloroform (TCA) will be gone after 1995. For the other popular chlorinated solvents- trichloroethylene, methylene chloride, and perchloroethylene- the end will not come this year or next year or even five years from now. But, I believe, the end is in sight. The handwriting is on the wall, and the clock is ticking away, marking time until regulators achieve their goal of making chlorinated solvent vapor degreasing a totally uneconomic parts cleaning option for small job shop metalworking companies."*

The Montreal Protocol and the 1990 Clean Air Act Amendments provide significant incentives to companies using CFC-113 or TCA to move away from those substances in their cleaning applications. But rather than switching to another, less regulated solvent, companies should be encouraged to use this development to look at a wide variety of metal cleaning and degreasing methods other than the use of chlorinated solvents. Shifting from one of these chlorinated solvents to another is only postponing the inevitable. Companies should be encouraged to begin looking for an economically sound, effective, and environmentally benign solvent for their equipment and parts cleaning operations. Making that change now will position them in such a way so as not to be affected by future regulatory changes.

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* Burch, David, "Chlorinated Solvent Vapor Degreasing: The Clock is Ticking," Water-Based Alternatives to Solvent Cleaning, proceedings from a teleconference sponsored by the Cleveland Advanced Manufacturing Program on February 11, 1993.

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PROPERTIES OF COMMON CLEANING AND DEGREASING SOLVENTS

SOLVENT	SOLVENCY FOR METAL WORKING SOILS	TOXICITY (PPM)	FLASH POINT†	EVAPORATION RATE (WATER=1)	WATER SOLUBILITY (WT %)	BOILING POINT (RANGE
Alchohols						
Ethanol	Poor	1000	60° F	24.7	100	165-176°
Isopropanol	Poor	400	55° F	19	100	170-181°
Methanol	Poor	200	58° F	45	100	147-149°
Aliphatic Hydrocarbons						
Heptane	Good	500	<20° F	26	<0.1	201-207°
Kerosene	Good	500	149° F	0.63	<0.1	324-525°
Stoddard	Good	200	105° F	2.2	<0.1	313-380°
Mineral Spirits 66	Good	200	107° F	1.5	<0.1	318-382°
Aromatic Hydrocarbons						
Benzene	Good	10	10° F	132	<0.1	176-177°
SC 150	Good	200	151° F	0.48	<0.1	370-410°
Toluene	Good	200	45° F	17	<0.1	230-232°
Turpentine	Good	100	91° F	2.9	<0.1	314-327°
Xylene	Good	100	81° F	4.7	<0.1	281-284°
Chlorinated Solvents						
Carbon Tetrachloride	Excellent	10	None	111	<0.1	170-172°
Methylene Chloride	Excellent	500	None	363	0.2	104-105°
Perchloroethylene	Excellent	100	None	16	<0.1	250-254°
1,1,1 Trichloroethane	Excellent	350	None	103	<0.1	165-194°
Trichloroethylene	Excellent	100	None	62.4	<0.1	188-190°
Fluorinated Solvents						
Trichlorotrifluoroethane (CFC 113)	Good	1000	None	439	<0.1	117° F
Ketones						
Acetone	Good	1000	<0° F	122	100	132-134°
Methyl Ethyl Ketone	Good	200	28° F	45	27	174-176°

III. Finding Pollution Prevention Opportunities

Before exploring specific pollution prevention techniques, a firm needs to investigate its particular process to determine where environmental problems and process inefficiencies arise and the reason for their existence. Only then can sound, cost-effective decision-making be made on specific pollution prevention options. The purpose of this module is to provide trainees a method of analysis which enables them to answer two important questions:

1) what aspects of my metal cleaning operations are especially appropriate for pollution prevention investigation, and
2) where to focus resources and attention.

The method of analysis prescribed in this module is designed to help companies pinpoint issues and pollution prevention opportunities pertaining to their particular operations. After completing this chapter, trainees should have the necessary skills to investigate their own operations, think strategically about their own unique environmental management problems, and make choices about pollution prevention which best satisfy their own production and operations needs.

The section is divided into three sections: introduction to process flow analysis, gathering information, and targeting operations

Process Flow Diagrams

Process flow diagrams can be extremely helpful in assisting industry to come to a greater understanding of their waste generating processes. The flow diagram allows the industrial generator to analyze his or her generating activity on a process level, tracking all inputs to the system (including energy) as well as tracking the system outputs to their final disposition. This exercise helps refine a generators understanding of the types of waste they generate by tying it to the process that results in its generation.

description

Process flow diagrams can be broken down into four major components:

- Inputs: any material apart from primary process equipment that is introduced into the process at any point in its operation (includes water, energy, and hand tools).
- Unit Operations: a description of the operating steps of the process. This helps catch

process components (hand tools, etc.) that might otherwise not be noted.

- Outputs: any material or waste stream that is generated as a result of the operation of the process equipment (includes fugitive emissions).
- Output Disposition: a description of the destination of the outputs from the process.

The diagram is used to trace the movement of materials through the process. By identifying all the constituents and products of a process and connecting them graphically, the process flow diagram illustrates the relationship between process feedstocks and waste product. Additionally, the diagram highlights some inputs and waste streams that might otherwise be overlooked in other types of analyses.

example

The process flow diagram that is used as an example in this guide represents one of the simplest cleaning and degreasing processes currently used by industry. This process will also be used later in this section as the basis for a cause and effect analysis.

The cold dip cleaning tank, the basis of this example, is so prevalent that it is likely that some will fail to recognized it as a process which results in hazardous wastes. It is also the kind of process that generates waste streams that are easily overlooked. This example should play well with an industrial audience.

The process we are using as an example is a 30 gallon cold dip tank which is used to clean small parts for repair or inspection. The solvent used in the tank is trichloroethylene, a solvent common to this type of operation. The tank is generally kept about three-quarters full of solvent and is covered with an single-piece hinged top when it is not in use. This tank is one of 10 similar tanks situated in maintenance areas of a large paper mill.

Maintenance on the cleaning tank is irregular. New solvent is introduced on an as needed basis and the sludge is removed whenever someone thinks of it.

The type of parts that are cleaned in the tank vary greatly in their configuration and the soils they contain. Old parts that are cleaned in preparation for repairs tend to contain the usual grease and oil residue along with paper dust, metal fines, dirt, burnt rubber, and paint. New parts are also cleaned before installation to remove any machining oils that would

make them difficult to handle. Mechanics sometimes place the newly cleaned parts in a basket hung in the tank above the solvent to allow the parts to drain, but usually parts are sprayed dry with compressed air after cleaning. The brush used to scrub the parts remains in the tank when not in use.

The waste solvent and sludge from these tanks are collected at a central location in the facility and shipped off site for recycling and/or disposal per RCRA requirements.

presenting the example

The primary objective of developing a process flow diagram is to identify the movement and/or conversion of all materials in an industrial process. When explaining the example provided here, it may be a good idea to sketch out the process and ask the industrial clients to provide the inputs and outputs rather than simply presenting them. By asking the clients to provide this information from the example, you allow them to think themselves through the process which is what they will have to do in their own shops. A handout describing the example is provided in the Resources of this section.

Information Gathering and Materials Accounting

The second part of this section discusses gathering and using existing facility information for pollution prevention planning. Useful information for pollution prevention planning and evaluation can be found in existing facility records. The sources include facility TRI reports, hazardous waste manifests, MSDS, permits, and purchasing and inventory records.

Agency staff should be cautioned against overselling the value and helpfulness of existing facility information. Generally, facility information provides a good starting point, but pollution prevention investigators will quickly realize that information "holes" exist which can only be filled by direct observation, monitoring, and process reviews.

Materials accounting, or balancing, is a method of analyzing the information you have gathered to make sure that substantially all material flows have been accounted for somewhere in the process. Although similar to mass balancing, it is far less rigorous relying instead on purchasing records, regulatory paperwork, and other readily available information to provide semi-quantitative data on the size and types of material flows. Together, the process flow

diagram and materials accounting conveniently summarizes key elements and relationships of the manufacturing process.

Targeting Operations

At this stage, assessors should have a fundamental understanding of the physical flows of materials through all stages of the process. The third and final step is to pinpoint areas for improvement.

description

Cause and effect analysis is advocated in this manual as a useful strategy for uncovering "root causes" of inefficient materials flows and process losses. Commonly used in total quality management programs, it is a simple but effective method for identifying specific opportunities for improvement.

Cause and effect analysis assumes a problem has been identified--either through process flow investigation,or more informally through meetings, or by simply seeing the effects on the production line. A "fishbone diagram" is assembled to provide a visual representation of "why things happen" in the process. The diagram helps pollution prevention assessors to systematically review the sources of the problem and all contributing factors.

Cause and effect analyses are important to this audience for two primary reasons:

1. Industrial clients are problem-oriented -- The industry practitioners you come in contact with are likely to attend because they have specific environmental problem in mind and are seeking a solution. This basis for this analysis is an existing problem, not a procedure. It allows them to focus directly on the topic of concern to their facility.

2. Industrial clients have limited information gathering and analysis capacity --Although a preferred strategy for conducting an assessment, full process flow analysis with its associated data gathering and analysis can be quite time-consuming. Many clients may realize the value of this type of investigation, but may feel they do not have the time or resources.

Cause and effect analysis can also be done independently of process flow investigation. While data gathering and verification will still be required, the overall time and resource investment will be lessened.

example

Using the same cold dip tank example as was used with the process flow diagram exercise, clients should be led through the cause and effect, or "fishbone", diagram.

factors affecting performance

Following are a number of variables affecting the performance of this process. It is a good idea to try to encourage clients to ask questions about operating practices that would uncover these variables.

- The single-piece hinged top allows for a substantial amount of solvent loss to the air. The motion of raising the cover pulls solvent vapors out of the tank, accelerating the loss of solvent to the air. The design of the tank cover also facilitates bad operating practices because it must be hooked to the wall to remain in an open position.
- Dragout of the solvent is substantial in this system. Operators usually do not allow the solvent to drain off the clean parts long enough to keep from dragging it out of the tank. The regular use of compressed air to blow dry the parts exacerbates this situation.
- Contaminated gloves and brushes used in the tank should be treated as hazardous waste because the have absorbed solvent. They have not traditionally been treated in that way in this operation.
- The irregular maintenance of these dip tanks in the facility can affect the recyclability of the solvent.

Resources

Sample PFD Process

Bibliography

Robert Pojasek and Lawrence Cali, "Contrasting Approaches to Pollution Prevention Auditing," Pollution Prevention Review, Summer 1991

Cold Cleaning Tank

The process we are using as an example is a 30 gallon cold dip tank which is used to clean small parts for repair or inspection. The solvent used in the tank is trichloroethylene, a solvent common to this type of operation. The tank is generally kept about three-quarters full of solvent and is covered with an single-piece hinged top when it is not in use. This tank is one of 10 similar tanks situated in maintenance areas of a large paper mill.

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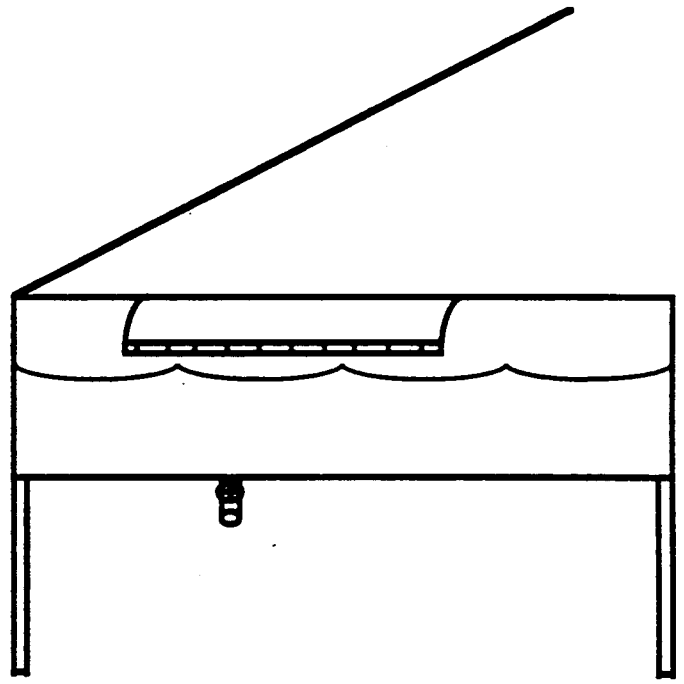

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Much has been written on conducting pollution prevention assessments. Several states (Minnesota, Oregon, Massachusetts, Washington, and California to name a few) have developed guides and assistance manuals describing the procedures involved in pollution prevention planning. Trade associations, such as the Chemical Manufacturers Association have developed planning guides for members companies. Although these guides may be written with a particular region or industry in mind, the general lessons and procedures are likely applicable to most operations.

Application of Total Quality Management Tools to Pollution Prevention

Total Quality Management: A Primer, Global Environmental Management Initiative, (1992), Washington DC

Corporate Quality/Environmental Management: Proceedings of the First Conference, Global Environmental Management Initiative, (1991), Washington DC

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Contrasting Approaches to Pollution Prevention Auditing

Robert B. Pojasek and Lawrence J. Cali

Most pollution prevention audit teams currently use protocols developed for compliance auditing. The inability of these prescriptive audit protocols to describe the functionality of the process limits their effectiveness. This paper presents a descriptive audit approach designed to provide the in-depth understanding of the process that is essential for the development of meaningful reduction opportunities. Ways in which the traditional audit approach can be integrated with the descriptive approach to provide a more effective audit tool are also considered.

As the number of environmental regulations continues to grow, compliance auditing of industrial facilities has become increasingly important. The many auditing protocols developed over the past fifteen years all seek to expedite the collection of the large amount of information needed to assess a facility's compliance. Checklists, worksheets, and questionnaires that direct the audit process form the heart of this directive approach or "prescriptive" audit approach.

Today, however, many companies are adopting a proactive stance toward environmental regulation by implementing pollution prevention programs. A key element in the success of such programs is the pollution prevention audit. The aim of a pollution prevention audit is not to assess a facility's compliance with existing environmental regulations, but to identify and eliminate or reduce the sources of pollution. Nevertheless, these audits are often performed using a prescriptive approach similar to that used for compliance auditing.

A more useful technique for auditing pollution prevention programs might be what has been termed a "descriptive" audit approach, that is, one that focuses on describing processes and their associated wastes. In this article we discuss both the prescriptive and descriptive approaches and their relative merits. Knowing the advantages of each approach and how they might be successfully combined can improve the effectiveness of pollution prevention audits.[1]

The Prescriptive Audit Approach

When initially confronted with the need to reduce environmental releases and waste generation, environmental scientists and engineers typically use compliance audit procedures to assess waste reduction opportunities. Environmental professionals had substantial training and experience in using these procedures, so it is not surprising that they applied them to the area of pollution prevention. The widespread use of this prescriptive approach led to its adoption by the U.S. Environmental Protection Agency (EPA). With the publication of the Waste Minimization Opportunity Assessment Manual by the EPA,[2]

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the prescriptive audit approach became the most widely recognized and implemented procedure for pollution prevention audits. Many states, including Oregon, New York, Connecticut, Washington, and Minnesota, have now adopted the prescriptive approach for their pollution prevention programs.

The prescriptive audit process is described in detail in the EPA manual and in Chapter 3 of *Hazardous Waste Minimization*.[3] **Figure 1** shows the steps in the prescriptive audit process and how it fits into the larger pollution prevention assessment program. It is clear that worksheets (checklists and questionnaires) form the heart of the prescriptive approach. **Figure 2** shows one such worksheet from the EPA manual. Each of these worksheets is designed to facilitate collection and organization by category of important process data.

Figure 1. The Prescriptive Audit Process

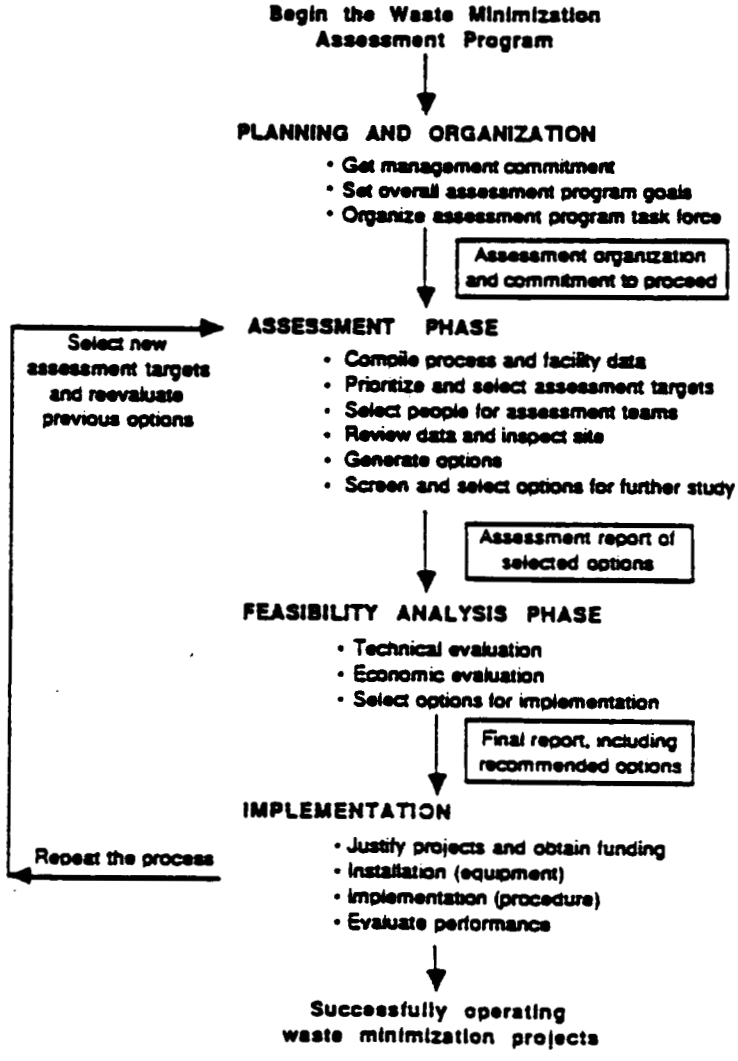


Figure 2. Sample EPA Worksheet

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____		Checked By _____
Date _____	Proj. No. _____	Sheet 1 of 1 Page __ of __

WORKSHEET 7

INPUT MATERIALS SUMMARY

EPA

Attribute	Description[1]		
	Stream No.___	Stream No.___	Stream No.___
Name/ID			
Source/Supplier			
Component/Attribute of Concern			
Annual Consumption Rate			
Overall			
Component(s) of Concern			
Purchase Price, $ per _____			
Overall Annual Cost			
Delivery Mode[2]			
Shipping Container Size & Type[3]			
Storage Mode[4]			
Transfer Mode[5]			
Empty Container Disposal/Management[6]			
Shelf Life			
Supplier Would			
- accept expired material (Y/N)			
- accept shipping containers (Y/N)			
- revise expiration date (Y/N)			
Acceptable Substitute(s), if any			
Alternate Supplier(s)			

1 stream numbers, if applicable, should correspond to those used on process flow diagrams.
2 e.g., pipeline, tank car, 100 bbl. tank truck, truck, etc.
3 e.g., 55 gal. drum, 100 lb. paper bag, tank, etc.
4 e.g., outdoor, warehouse, underground, aboveground, etc.
5 e.g., pump, forklift, pneumatic transport, conveyor, etc.
6 e.g., crush and landfill, clean and recycle, return to supplier, etc.

Table 1 lists the EPA waste minimization worksheets and their respective purposes. The categories dealt with include:

- Raw materials
- Finished products
- Process wastes
- Equipment design
- Maintenance
- Personnel organization

Table 1. EPA Waste Minimization Assessment Worksheets

Worksheet	*Purpose*
Site Description	Lists background information about the facility, including location, products, and operations.
Personnel	Records information about the personnel who work in the area to be assessed.
Process Information	This is a checklist of useful process information to look for before starting the assessment.
Input Materials Summary	Records input material information for a specific production or process area. This includes name, supplier, hazardous component or properties, cost, delivery and shelf-life information, and possible substitutes.
Products Summary	Identifies hazardous components, production rate, revenues, and other information about products.
Individual Waste Stream Characterization	Records source, hazard, generation rate, disposal cost, and method of treatment or disposal for each waste stream.
Waste Stream Summary	Summarizes all of the information collected for each waste stream. This sheet is also used to prioritize waste streams to assess.

The checklists are quite comprehensive. No important source of data is overlooked. Even for small facilities, the amount of information to be collected can be quite large.

Advantages of the prescriptive approach

The prescriptive audit approach offers several advantages. Checklists and worksheets used in this type of audit provide a standardized approach that can be used by almost anyone. Specialized audit training or detailed process knowledge are not really needed because the forms provide the necessary structure and direction. As a result, the audit team can include nontechnical personnel from areas such as purchasing or finance. Finally the comprehensive nature of the checklists ensures that the audit team does not overlook important information.

Disadvantages of the prescriptive approach

Despite these advantages, the prescriptive audit approach leaves a great deal to be desired. This is not unexpected because the objective of a pollution prevention audit is quite different from that of a compliance audit. In a pollution prevention audit the auditor must not only identify process wastes but also their sources. This requires understanding the interrelationships among process elements. For example, raw material usage data must be correlated with scrap and waste generation rates. Although the checklists ensure that material usage and waste generation data are collected, they do not make clear how the data interrelate or to what process they apply. This basic shortcoming of the prescriptive approach has become more apparent now that companies are moving beyond good housekeeping procedures into more fundamental, process-related reduction measures.

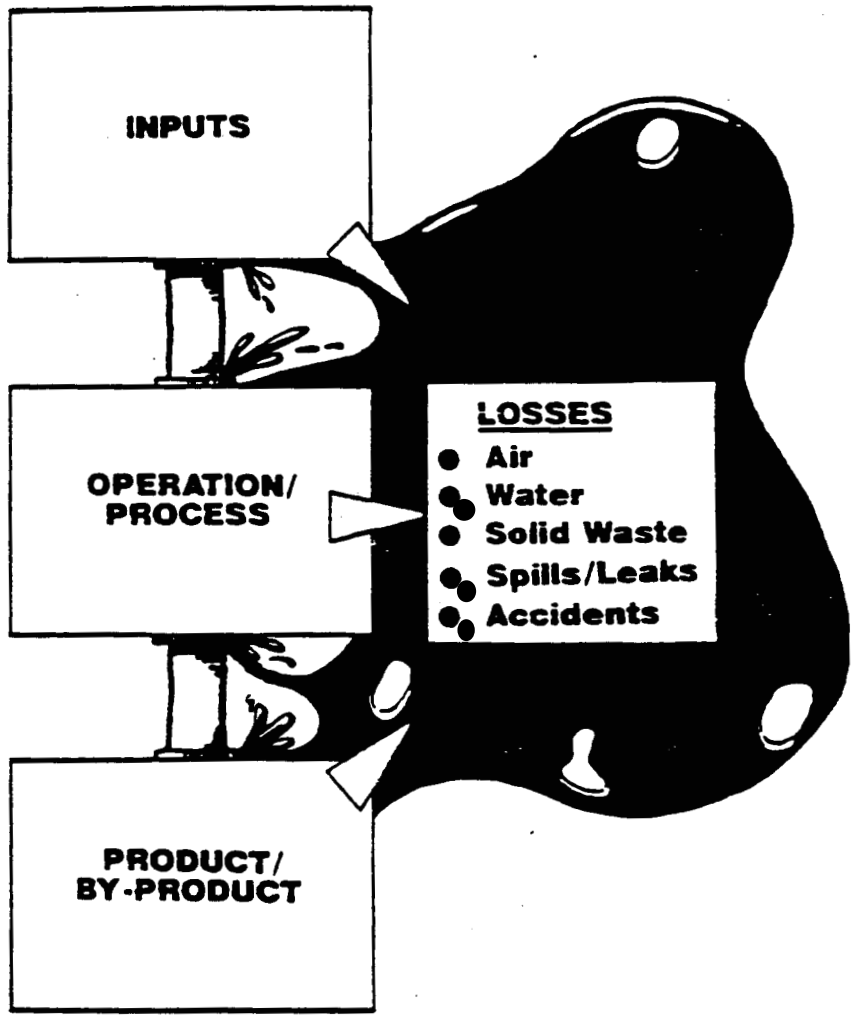
Given the shortcomings inherent in the prescriptive approach, it is only natural to look for alternative auditing methods. One possibility is to make the process itself the central focus of the audit and to view wastes and releases as process losses.

Another drawback of the descriptive approach is the generic nature of the checklists. Users of the checklists in the EPA manual have found that many of them are not applicable to their manufacturing operations. Auditors find that reworking the checklists to suit their facility's needs requires a significant amount of effort. The EPA, recognizing this problem, has recently published customized versions of checklists for seven selected industries.[4] Users in other industries, however, must still do their own customizing.

The Descriptive Approach

Given the shortcomings inherent in the prescriptive approach, it is only natural to look for alternative auditing methods. One possibility is to make the process itself the central focus of the audit and to view wastes and releases as process losses. This concept is illustrated in **Figure 3**. The left side of Figure 3 shows the throughput sequence of any industrial operation. Because the use of chemicals is rarely 100 percent efficient, there are losses of chemicals from the operation as depicted. There can also be losses of the inputs (e.g., shelflife expiration of stored feedstocks) and the products (e.g., defective or otherwise

Figure 3. Conceptualization of the Industrial Process



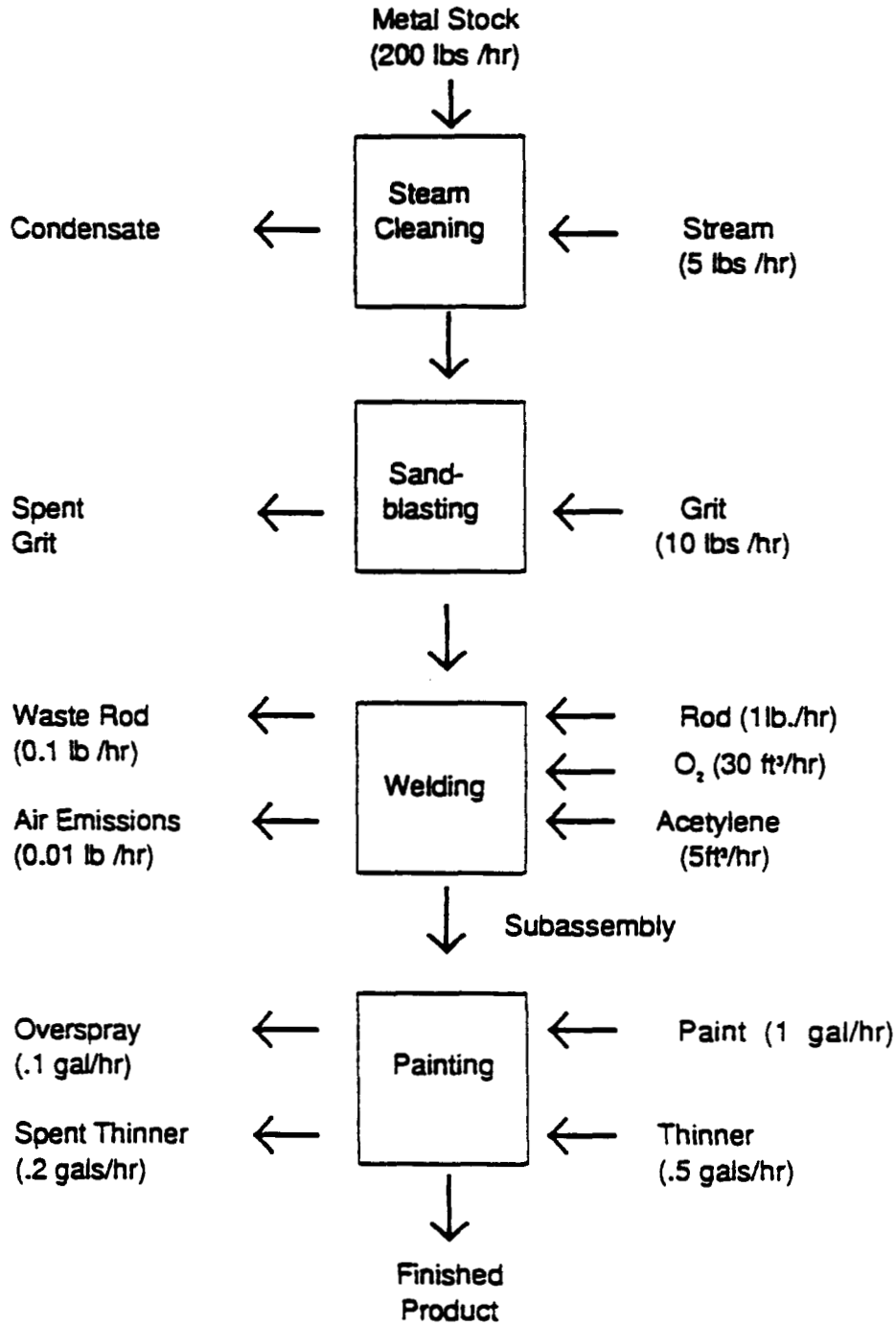
nonfunctional products). The goal of the descriptive audit approach is then to identify all potential process losses so that appropriate reduction measures can be implemented.

The two basic components of the descriptive approach are a process flow diagram and a materials accounting. **Figure 4** shows an example of a process flow diagram constructed for a metal parts manufacturing facility. The magnitude of the process flows, developed from a materials accounting, are also noted on the diagram.

Constructing a process flow diagram

A process flow diagram depicts the series of steps through which the input materials pass in the course of their transformation into product. For any operation, be it the manufacture of chairs of the maintenance of a pump, there is a functional sequence of events or actions. One action initiates others, which in turn initiate still others until the overall function is completed, resulting in some kind of out-

Figure 4. Metal Parts Process Flow Diagram



put. The process flow diagram clearly illustrates the functional sequence. The knowledge of the process that is gained from using the process flow diagram is critical, because only by understanding the process can one hope to change it to reduce losses.

The first step in constructing a process flow diagram is to identify

the fundamental or unit operations that lead to the final product or the end result of the process. In the metal parts process depicted in Figure 4, the unit operations consist of steam cleaning, sandblasting, welding, and painting. Figure 5 shows a maintenance procedure that includes the operations of disassembly, degreasing, inspection, repair, and reassembly. The unit operations are shown as blocks on the diagrams. Material flows into and out of each operation are depicted as arrows. Each arrow is labeled to identify the material being represented. Wastes are shown on the diagram just like any other material flow.

For a complex process, preparing a workable process flow diagram generally requires subdividing the process into two or more subprocesses.

It is important to recognize that the arrows can indicate material flows in time as well as through equipment. In the maintenance procedure shown in Figure 5, the arrows depict the pump as it undergoes the sequence of operations over time. The pump itself will be stationary during most of the process.

For a complex process, preparing a workable process flow diagram generally requires subdividing the process into two or more subprocesses. Efforts can then be focused on developing a diagram for the more promising subprocess. The other subprocesses can be addressed by other teams or as available resources permit.

Materials accounting

A materials accounting for a process is similar to an engineering mass balance in that it attempts to quantify and balance process inflows and outflows. The materials accounting, however, is much less rigorous than is a mass balance. The purpose of a materials accounting is to ensure that substantially all material flows have been accounted for. Purchasing records and other readily available information are used to provide semiquantitative data on the size of each material flow. Installation of flow meters or other stream monitoring equipment is not generally performed.

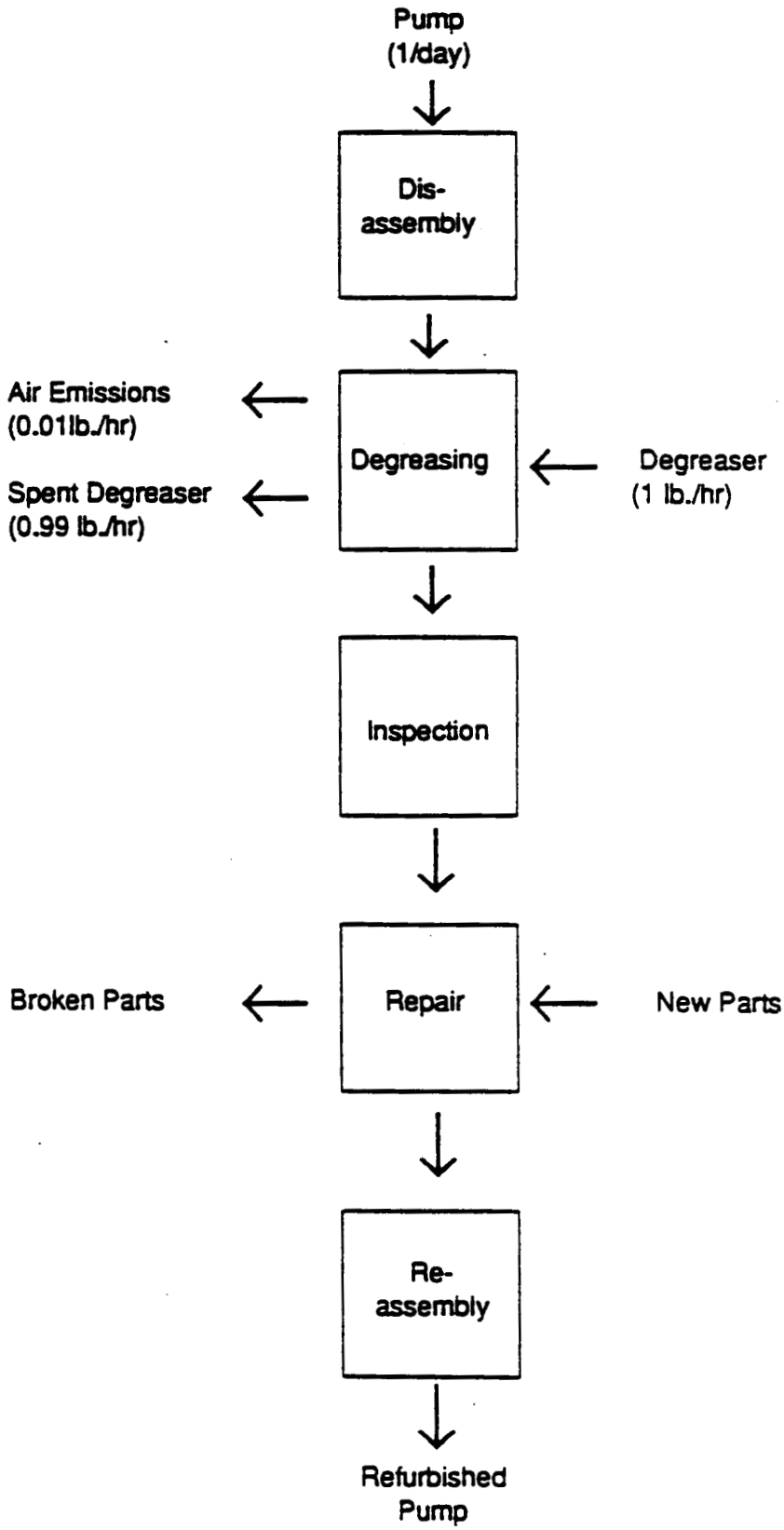
Descriptive audit process

The process flow diagram and materials accounting are prepared before the audit team's tour of the facility. Preparation of the diagram can be the responsibility of an individual or the team as a whole. The plan tour is then used to verify that the diagram accurately depicts the process as it operates in the plant. Areas of opportunity where further investigation seems warranted can be easily highlighted on the diagram. After completing the audit, the audit team has an in-depth understanding of the process and the sources of the process losses.

Advantages of the descriptive approach

The descriptive approach has many advantages when compared with the use of checklists. Information gathering using the descriptive approach is much more focused. All information that is collected contributes directly to the team's understanding of the fundamental aspects of the process. The process flow diagram conveniently sum-

Figure 5. Pump Maintenance Operation



marizes this information in one or two sheets.

Additionally, the descriptive approach is dynamic and can be used to describe any type of operation. Production and maintenance operations can be conceptualized using these diagrams. The diagrams can accommodate any sequence of operations, including series flows, and recycling streams. The need to customize checklists to fit a particular process or industry is eliminated.

Most importantly, the process flow diagram makes clear the source of each loss. Knowing the source of each loss provides the foundation upon which ideas for reducing or eliminating the loss can be developed.

Disadvantages of the descriptive approach

The descriptive approach, despite its power, does have some drawbacks. The most important of these is that the descriptive approach is potentially more technically demanding than the prescriptive approach. A technical background and some familiarity with the process are generally required to prepare a meaningful process flow diagram. This additional expertise may not be available in a small facility.

This disadvantage does not present an insurmountable problem. There are a number of excellent references that discuss the basics of preparing a process flow diagram.[3] Alternatively, the required expertise can be supplied by an outside consultant or agency.

A Combined Audit Approach

The descriptive audit approach is a fundamental approach to pollution prevention auditing in that it identifies the sources of losses, making it much easier to develop meaningful reduction alternatives. This is not to imply that the descriptive approach is the only approach that can be used or that the prescriptive approach cannot work. In fact, many facilities have made significant and rapid progress using simple checklist audits.

For small facilities with limited resources, a prescriptive audit can be inexpensively implemented and can improve operating practices. For larger, more complex facilities, a descriptive audit can lead to more fundamental waste reductions.

In presenting the descriptive approach, the aim has been to provide environmental professionals and others with another tool for auditing. Common sense dictates that whatever approach is selected should be based on the task at hand. For small facilities with limited resources, a prescriptive audit can be inexpensively implemented and can improve operating practices. For larger, more complex facilities, a descriptive audit can lead to more fundamental waste reductions. Checklists can be used to collect information needed to fill the data gaps identified during development and verification of the process flow diagram.

Verification of the process flow diagram leads both the inspectors and the equipment operators to a true understanding of the functionality of the equipment and the manner in which chemical losses can occur. Without this approach, an operator usually contemplates how to operate the equipment but does not focus on what is actually

happening. By understanding what causes the losses, ideas for equipment redesign, material substitutions, or changes in process conditions that will reduce the losses can be more easily developed.

Such a combined audit approach was informally tested using the student teams taking a pollution prevention course at Tufts University. Teams used both the prescriptive approach and the descriptive approach to audit a single process. The students expressed a strong preference for the descriptive approach because it allowed them to understand the functionality of the process. Nevertheless, they saw value in the checklists as a vehicle for collecting important process information and for assessing the completeness of the descriptive audit.

The key to a successful pollution prevention audit is to clearly identify at the start the audit's objective and resource constraints and choose an approach based on these factors.

In Conclusion

The key to a successful pollution prevention audit is to clearly identify at the start the audit's objective and resource constraints and choose an approach based on these factors. For companies that have the appropriate resources, the descriptive audit is a targeted approach that can help develop a rapid understanding of the relationship between wastes and the manufacturing process.[6] Incorporating the descriptive audit approach into pollution prevention audits can help companies move beyond first-tier opportunities to achieve fundamental reduction in waste generation. It is expected that use of the descriptive approach will increase as the shortcomings of the prescriptive approach become more apparent. ●

Notes

1. In "Waste Reductions Audits," in Eric B. Rothenberg and Dean J. Telego (eds.), *Environmental Risk Management—A Desk Reference* (RTM Communications, 1991), Dr. Pojasek introduced the concept of the descriptive pollution prevention audit and also discussed the idea of using this approach for independent validation of existing pollution prevention programs. Readers may wish to refer to this article for more information on this aspect of the audit process.

2. United States Environmental Protection Agency, *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988).

3. Deborah Hanlan and Carl Fromm, "Waste Minimization Assessments," in Harry Freeman (ed.), *Hazardous Waste Minimization* (McGraw-Hill, 1990).

4. These checklists are in the Guides to Pollution Prevention for: The Pesticide Formulating Industry (625/7-90-004), The Paint Manufacturing Industry (625/7-90-005), The Fabricated Metal Industry (625/7-90-006), The Printed Circuit Board Manufacturing Industry (625/7-90-007), The Commercial Printing Industry (625/7-90-008), Selected Hospital Waste Streams (625/7-90-009), and Research and Educational Institutions (625/7-90-010). All guides are available from CERI, Technology Transfer, USEPA, P.O. Box 19963, Cincinnati, OH 45219-0963.

5. See, for example, Ernest E. Ludwig, *Applied Process Design for Chemical and Petrochemical Plants* (Gulf Publishing, 1964) and J. P. O'Donnell, "How Flowsheets Communicate Engineering Information," *Chemical Engineering* (McGraw-Hill, 1957).

6. The manner in which this descriptive audit approach fits into an overall pollution prevention program is described by Dr. Pojasek in "Pollution Prevention Progression," in Eric B. Rothenberg and Dean J. Telego (eds.), *Environmental Risk Management—A Desk Reference* (RTM Communications, 1991).

IV. Metal Cleaning and Degreasing Alternatives

Companies that find it necessary to clean parts or equipment as a regular aspect of their production process have been put on the spot. As halogenated solvents rise in price and become less available, companies using even the smallest amount of such solvents will find it necessary to be much more careful in the way they handle and apply these increasingly expensive substances. The labelling regulations that require any item that comes in contact with one of these halogenated solvents in its assembly to carry a label on it identifying it as such place a further burden on companies using these substances. Add to this the cradle-to-grave responsibility assumed by all generators of hazardous waste and you have a situation where there is mounting pressure to discontinue the use of these substances.

Large manufacturing concerns have made a concerted effort to search for new, non-halogenated cleaning systems. Seeing the handwriting on the wall, these companies began researching and testing various non-halogenated cleaning systems, some as early as 1980, intending to change-out their cleaning systems ahead of expensive regulation. Many of these large companies have successfully changed their metal cleaning systems in such a way as to eliminate the use of halogenated solvents in cleaning applications.

But not everyone has the resources of Digital Equipment Co. or General Dynamics. As it becomes more and more expensive to use halogenated solvents and dispose of their wastes, small and medium sized companies have been put under increasing pressure to reduce or eliminate their use of these materials. This manual is directed primarily at these kinds of companies.

Pollution Prevention Opportunities

Opportunities to reduce the amount and/or toxicity of waste being generated by a metal cleaning operation are plentiful. As we review these options in this module, we will divide them into three categories:

- process modifications: changes in the configuration or operation of an existing cleaning process that can result in a reduction in the amount and/or toxicity of waste generated.
- operating practice modifications: changes in the way an existing process is run or raw materials

are handled that can result in a reduction in the amount and/or toxicity of waste generated.
- material substitution: changes in the feedstock or other inputs to a process that can result in a reduction in the amount and/or toxicity of waste generated.

process modifications

Significant reductions in solvent loss and waste generation are achievable through the modification of existing cleaning process configuration and equipment. As with the other two types of pollution prevention options, I refer you to the lecture section of this module for the specifics.

The primary target of these process modifications is the fugitive emissions that escape the cleaning process. Fugitive emissions, aside from endangering worker health and depleting the ozone layer, rapidly deplete the solvent available for cleaning, increasing solvent costs and requiring more frequent solvent bath change-outs. By keeping the solvents in the bath rather than allowing them to escape as vapors, the cleaning process operator increases the likelihood that the solvent will be fully spent before it is sent off for reclamation or disposal.

These kinds of process modifications are important to the extent that they can begin an industrial generator down the road to sustainable environmental management. Most, if not all, the process modifications discussed can be implemented for relatively low cost and will result in significant, measurable savings primarily by reducing the amount of solvent needing to be purchased. As a result, a generator who has successfully implemented one or more of these pollution prevention options may be more favorably inclined, having already experienced some success with a change, to experiment with other process changes that could lead to further reductions in waste generation.

operating practice modifications

The second class of pollution prevention options available to metal cleaners lie in the way the process is run and raw materials are handled in the facility. A number of changes to the way a process is run, extending drain time over the cleaning bath or slowing the withdrawal rate of the parts out of the cleaning area for instance, can result in significant reductions in the amount of hazardous waste generated by the process.

Many of these operating practice changes are, like the process modifications mentioned earlier, relatively inexpensive to implement. But unlike changes to

process equipment or configuration, changes in operating practices often require the cooperation of the workers on the shop floor. Changing human behavior is not as easy as changing equipment. It takes a serious commitment on the part of plant managers, training supervisors, and shop foremen to work with process operators, carefully explain the reasons for the proposed change, understand their reasons for resisting the changes that are being proposed, and find the most acceptable way for all parties to modify operating practices in order to achieve the goal of pollution prevention.

Management will also be called upon to change the way in which they do their jobs. By being more aware of the impact work scheduling, production line changeouts, and the management of waste streams have on the generation of waste, the modification of such practices can result in significant reduction in solvent loss and waste generation.

Many of the changes in operating practices advocated in the name of pollution prevention are very much in line with the tenentes of "Just-In-Time" and Total Quality Management approaches. The proper management of feedstocks and careful monitoring of processes and other operating practices can often be included in these kind of larger management initiatives.

material substitution

From an environmentalist's point of view, these are the most attractive pollution prevention options available to process operators. From sustainable development point of view, moving away from the use of hazardous and toxic chemicals in cleaning operations toward more environmentally benign materials is in line with preparing a manufacturer to remain competitive in a long term sense. And certainly, the reduction in the amount of waste generated as a result of such a change is likely to be much more significant than the reductions resulting from the other two classes of process and practice modifications.

Changing the materials used in a metal cleaning process is, contrary to what some people will want you to believe, neither cheap nor easy. A successful move away from halogenated solvent cleaning requires a great deal of analysis. <u>All</u> the inputs into the cleaning system (soils, solvent components, parts substrate and configuration, energy, etc.) must be analyzed and quantified. The possible impacts on the timing of the production process must be estimated. And, of course, the costs of converting to the new

system must be figured. Review the case studies included in this module and you will get an idea of how much work goes into conversion to a non-halogenated cleaning system.

Remember, there are no perfect drop-in substitutes for halogenated solvents in metal cleaning applications. Most of the cleaning systems that are being promoted as replacements for halogenated solvents operate in very narrow cleaning windows and therefore require much more monitoring and tighter operating practices than halogenated solvents. Often energy in the form of heat or ultrasonic agitation is required to get these systems to work. The reason why halogenated solvents are so widely used in cleaning applications is that they are effective on a wide variety of soils and can be applied in a variety of ways. Converting to a system that requires more monitoring and is not as universally applicable a halogenated solvent system is bound to meet with some resistance.

Testing alternative systems on real world parts and soils is essential to choosing the appropriate cleaning system for the application. Manufacturers interested in getting out of halogenated solvent cleaning should be encouraged to work closely with a variety of vendors and look at a variety of options to assure themselves they are changing to the system that most closely meets their needs.

Resources

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The following is a bibliography of written resources related to the substitution of other cleaning methods in place of vapor degreasing of metal parts. The bibliography is the result of literature searches conducted by MnTAP over the period 11/91-4/92 of the:

MnTAP library
University of Minnesota Library
Compendex (1986-1991)
Chemical Abstracts
Metal Index & the PTS Newsletter Database (through Teltech Inc)
Ozonet

Searches were done as preliminary work under a Pollution Prevention Initiatives to States grant from the US EPA to the Minnesota Office of Waste Management.

The resources have been reviewed and classified by content into the following categories:

Selection of metal cleaners to replace chlorinated solvents[1]
Case studies on the substitution of aqueous cleaners[1]
Dealing with problem soils [1]
Miscellaneous methods for cleaning or avoiding cleaning[1]
Semi-aqueous metal parts cleaning
Miscellaneous Issues (rinsing, drying, etc):[1]
Treatment of Wastewaters from Industrial Metal Cleaning Operations
Cleaning Measurements[1]
Metal Cleaning - Introduction / Overview of Methods
Emission Reduction in Vapor Degreasers
Solvent Waste Reduction in Industrial Cleaning Operations

Most of the resources cited are avaiblable through libraries and MnTAP will not provide copies. However, there are a few cited resources which MnTAP has played a role in developing, and which may not be widely available. MnTAP will provide copies of the these (denoted by "*" following the citation number) on request.

[1] notes have been added to citations in these sections to further describe the content

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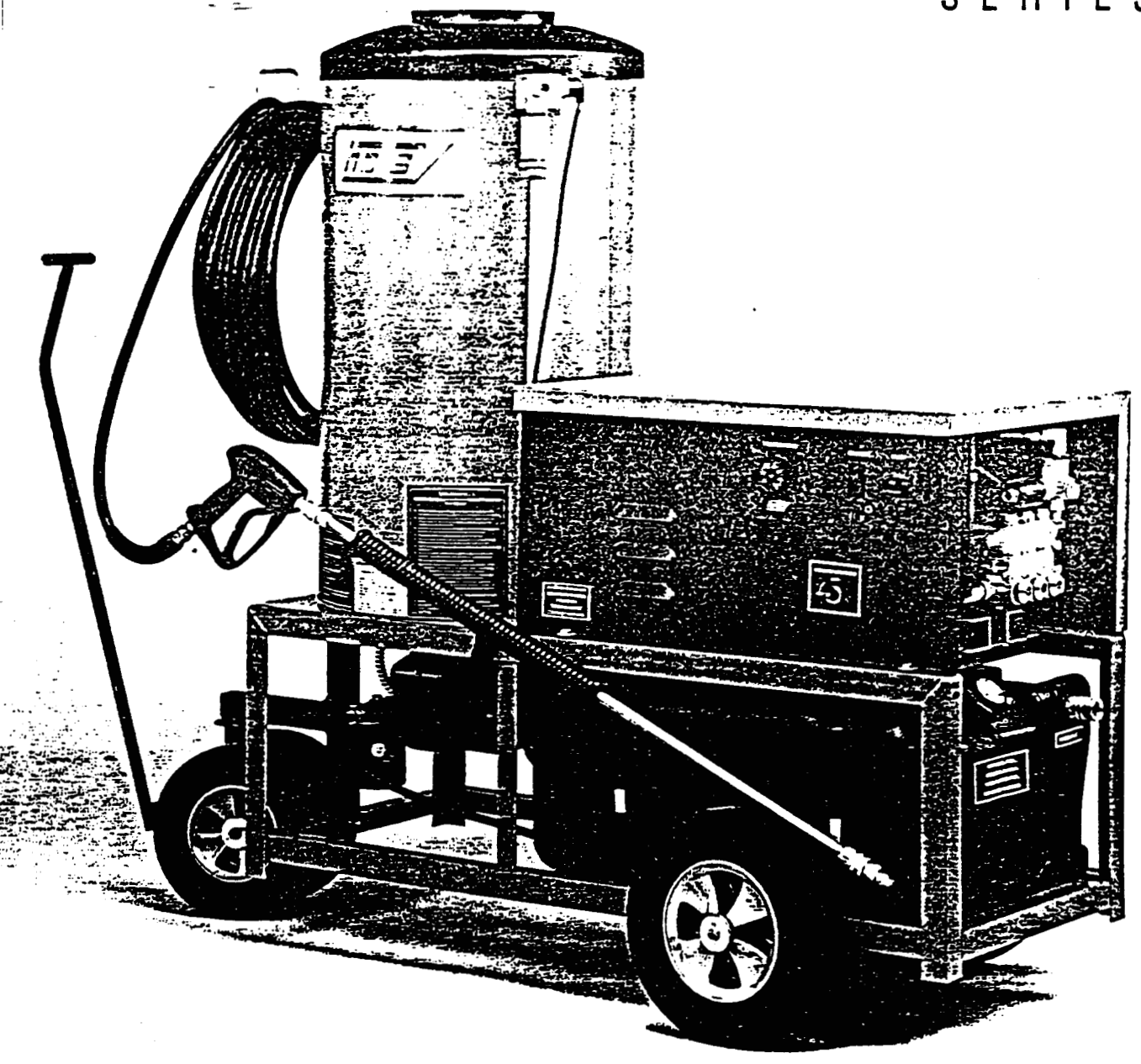

HOTSY FEATURES:	UNPAID-FOR BENEFITS:
■ 230-, 208/230- & 440-volt electric motors	■ Free Demos on site
■ Hawk triplex, high-performance pumps	■ Over 50 models to choose from
■ Vertically-fired oil, LP or natural-gas water heaters	■ Factory-trained service people
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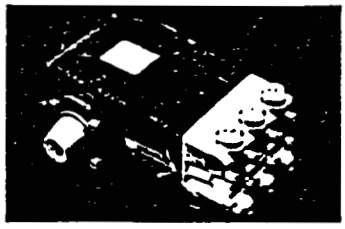
■ Full line of Hotsy accessories	■ Fuel, detergent & labor savings
■ Hotsy detergents for all applications	■ Quality warranty program

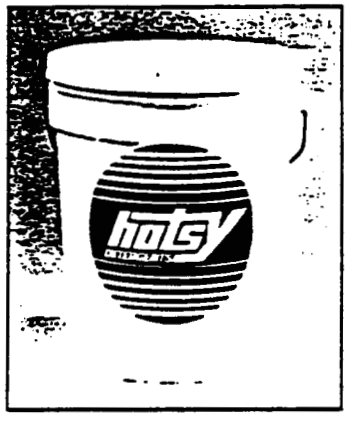
Competitively Priced For The Best Value For Your Dollar Now

...And Great Trade-In Value 5, 7, 10 Years From Now...

- Hotsy's high-powered, hot-water, high-pressure washers designed for heavy-duty equipment and "off-the-road" cleaning.
- 80% of Hotsy parts — components, chassis, safety controls, coils, pumps — are manufactured by Hotsy or built to Hotsy design.
- Motor and water heaters perform precisely to Hotsy specifications.
- **High-performance Hawk triplex, pump delivers 4 GPM at 2000 PSI.**
- Hawk pump delivers quiet, efficient operation, with minimal vibration and great durability.



- Hotsys are safe and easy to operate. Simple instructions are printed on the machine as well as in the Operating Manual.
- Hotsy's trigger gun conserves and controls water flow.
- Adjustable safety temperature controller lets you choose different temperatures for different cleaning jobs.
- Operators can add detergent easily for a variety of applications.
- **Add these Hotsy accessories to help clean faster, easier and better:** Adjustable spray-pattern nozzle...portable gear...extra hose lengths...hose reels...wand extensions...quick couplers...downstream detergent injector...wet sandblaster...rotating brush...foam applicator...and many, many more.
- **Hotsys perform best with Hotsy detergents...** formulated for Hotsys, by Hotsy, to be fast-acting, thorough cleaners.



- Hotsy detergents are highly concentrated and economical to use...a little Hotsy detergent goes a long, long way.
- Exclusive Advanced Formula HCC additives in Hotsy detergents continuously clean the lime and soap buildups in your machine caused by other brands of chemical or hard water in your machine...reducing wear, tear and downtime.
- There's a wide variety of Hotsy detergents for a wide variety of cleaning jobs and they're all formulated for high-temperature, high-pressure cleaning.
- Available in a variety of packages to meet your needs. Hotsy detergents are safe...biodegradable. USDA approved and most have Canadian Agriculture approval.
- **Hotsys are versatile, handling dozens of cleaning chores you haven't even thought of! We'll prove it with a FREE DEMO on site, at your place of business. Your Hotsy Man will also help you choose the Hotsy accessories and Hotsy detergents that are best for you. Ask for a FREE DEMO today!**

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THE HOTSY CORPORATION
21 Inverness Way East, Englewood, Colorado 80112-5796
(303) 792-5200 • TWX 910/935-0792 • FAX 303/792-0547

884908-B Printed in USA Effective 3/89 Supersedes 884908-A 5/87
Specifications and product descriptions subject to change without notice

Water	4 GPM (15.1 lpm); 240 GPH (908.4 lph).
Water	2000 PSI (140.6 kg/cm²).
Water	Hawk triplex, positive-displacement pump; ceramic plungers; brass manifold; oil-bath crankcase.
Electric	5-HP, 230 V, 208/230V or 440V; 60 Hz, 1 or 3 P; electric motors; drip proof.
Oil-Fired	385,000 BTU/hr. UL-listed burner, pressure-atomizing type, with automatic electric ignition. Your choice of #1 or #2 diesel, kerosene or #1 home heating oil as your fuel. Fuel filter standard. 11.5-gallon, removeable, rust-proof, non-contaminating, polyethylene, fuel-oil tank standard. Fuel gauge in cap. Models 987 & 997 CSA Approved.
Gas-Fired	350,000 BTU/hr. AGA-listed gas controls, ring-type with aspirating spuds; natural draft. LP gas standard. Vapor-type, LP-gas tank required, but not included. Natural gas optional. Models 989 & 999 CSA Approved.
Heating Coil	Vertically-fired; 7/8" OD; hydrostatic-pressure tested; 14,900 PSI burst-pressure rated. Heating coil is sheathed in a full-length, sheet-metal wrap, requiring no outer-wrap insulation. Equipped with an independently-welded, heat-retention baffle plate.
Stack	8" oil fired; 10" gas fired (gas-fired units require draft diverters).
Controls	Adjustable temperature controller, safety pressure relief valve, pressure switch, ON/OFF electric motor switch with overload protection, unloader, water heater switch, detergent valve and automatic, non-contaminating float valve.
Float-T	Removeable, rust-proof polyethylene.
Wand	Trigger gun control with cool grip, heavy-duty wand with insulated grips.
Nozzle	Three stainless steel; 0°, 15° and 40°.
Hose	3/8" ID, 50 ft., wire braid, 3,000 PSI working-pressure rated; burst pressure is at least 4 times working pressure; oil and chemical resistant. Swivel fittings both ends.
Paint	Optional.
Options	Adjustable spray-pattern nozzle, portable gear, extra hose lengths; hose reels, wand extensions, quick couplers, downstream detergent injector, wet sandblaster, rotating brush and foam applicator.
Construction	Heavy-gauge sheet; angle-iron frame.
Finish	High-gloss, baked enamel.
Dimensions	L-45" (114.3 cm); W-18" (45.72 cm); H-48" (121.92 cm).

1-phase, 230V, electric motor; oil fired water heater; shipping weight, 520 lbs.

1-phase, 230V, electric motor; LP-gas-fired water (natural gas optional); shipping weight, 490 lbs.

1-phase, 230V, electric motor; oil-fired water heater; CSA Approved; shipping weight, 525 lbs.

1-phase, 230V, electric motor; LP-gas-fired water heater (natural gas optional); CSA Approved; shipping weight, 495 lbs.

3-phase, 208/230V, electric motor; oil-fired water heater; shipping weight, 505 lbs.

3-phase, 208/230V, electric motor; LP-gas-fired water heater; shipping weight, 461 lbs.

3-phase, 440V, electric motor; oil-fired water heater; shipping weight, 520 lbs.

3-phase, 440V, electric motor; LP-gas-fired water heater (natural gas optional); shipping weight, 475 lbs.

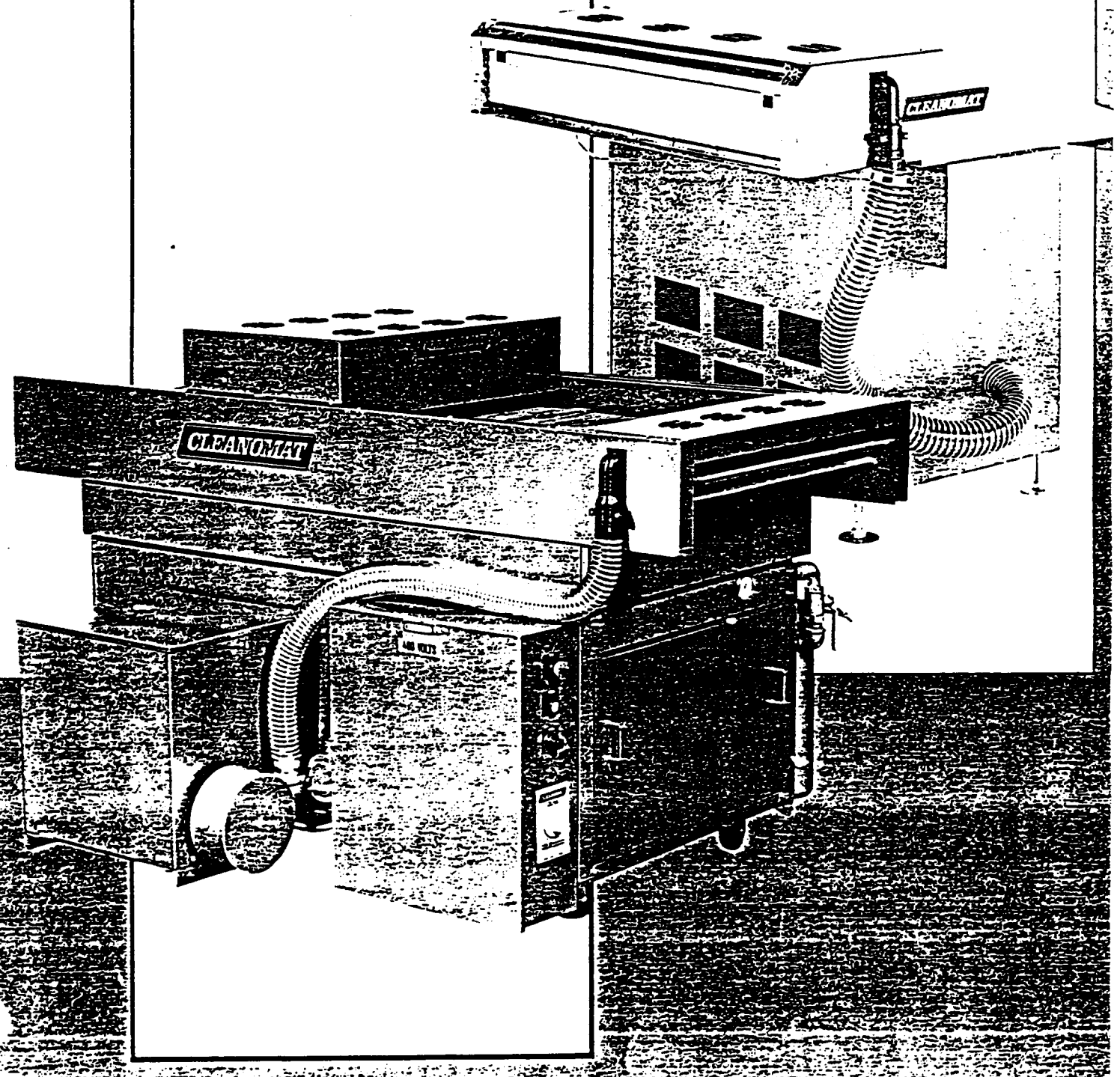
3-phase, 208/230V, electric motor; oil-fired water heater, CSA Approved; shipping weight, 510 lbs.

3-phase, 208/230V, electric motor; LP-gas-fired water heater (natural gas optional); CSA Approved; shipping weight, 480 lbs.

Cover Photo: Hotsy Model 990

HOTSY EQUIPMENT CO.
1900 Oakcrest Ave.
Roseville, MN 55113
(612) 636-4779

CLEANOMAT



Washers and Dryers for Flat Sheet Metal Parts

Washer/Dryers

Paying for themselves in only a few months, sheet metal washer dryers from CLEANOMAT increase your productivity, eliminate costly handwork, and reduce your labor and handling costs. They have proven themselves ideal for sheet metal fabricators, stampers, and fine blankers by removing oil, grease, and grinding grit as well as providing rust protection for stored or shipped parts. In addition, it also reduces wear on dies and other forming equipment. For additional cost savings, plastic spheres are provided for use within the tank to reduce evaporation of the cleaner and lower energy consumption.

Able to handle stock up to 3/16" thick with a minimum length of 4½", CLEANOMAT washer/dryers simultaneously clean and rustproof both sides of materials up to 60" wide. They feature pumps from 1.5 to 7.0 horsepower depending on the model selected.

With its adjustable conveyor speed, the CLEANOMAT washer/dryer provides stability in your production operations. It can be regulated to interface smoothly with the wide belt sanders on the market today removing bottlenecks due to temporary help shortages. That means you get reliable production rates day after day.

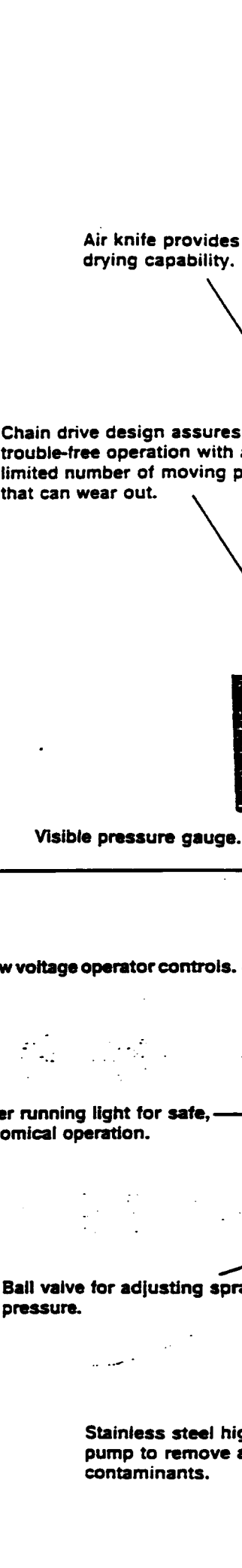
For information about machines capable of washing and drying three dimensional parts or other custom applications, contact the factory.

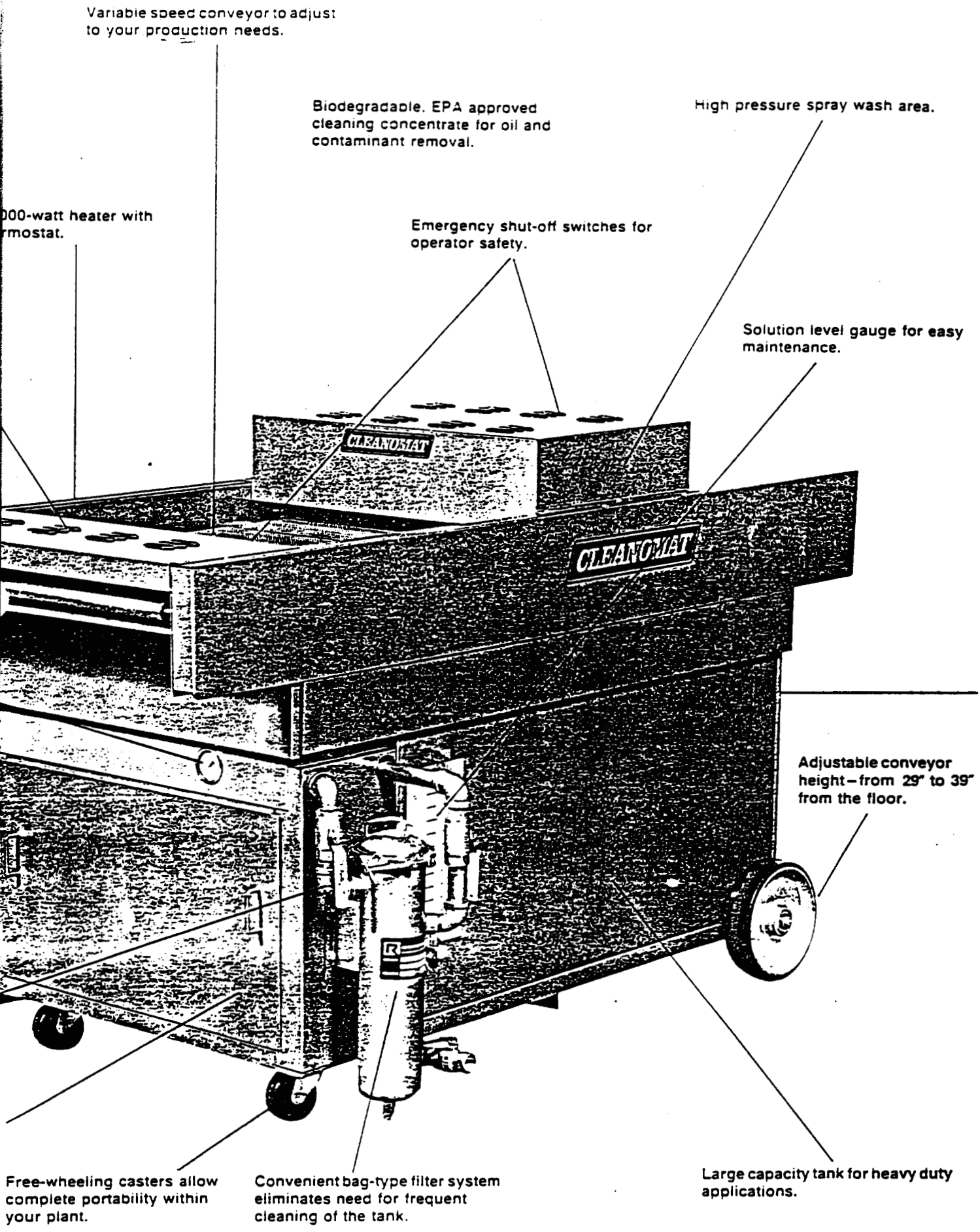
OPTIONS

Some optional features available with the CLEANOMAT washer/dryers include:

- Automatic liquid level control.
- Adjustable thickness control for materials up to 3/8" thick.
- 208-240 volt, 440-480 volt 3-phase, 575 volt 3-phase, or 50 cycle wiring.
- J.I.C. electricals with fuse disconnect.
- DMI-100 cleaning concentrate (5 gallons included with each machine).

Washer/Dryer Model No.	Capacity (Width)	Dimensions Length	Width	Height
CLHA-18	18"	76"	58"	42"
CLHA-24	24"	76"	58"	48"
CLHA-36	36"	76"	60"	48"
CLHA-42	42"	76"	64"	48"
CLHA-52	52"	86"	64"	54"
CLHA-60	60"	96"	76"	60"



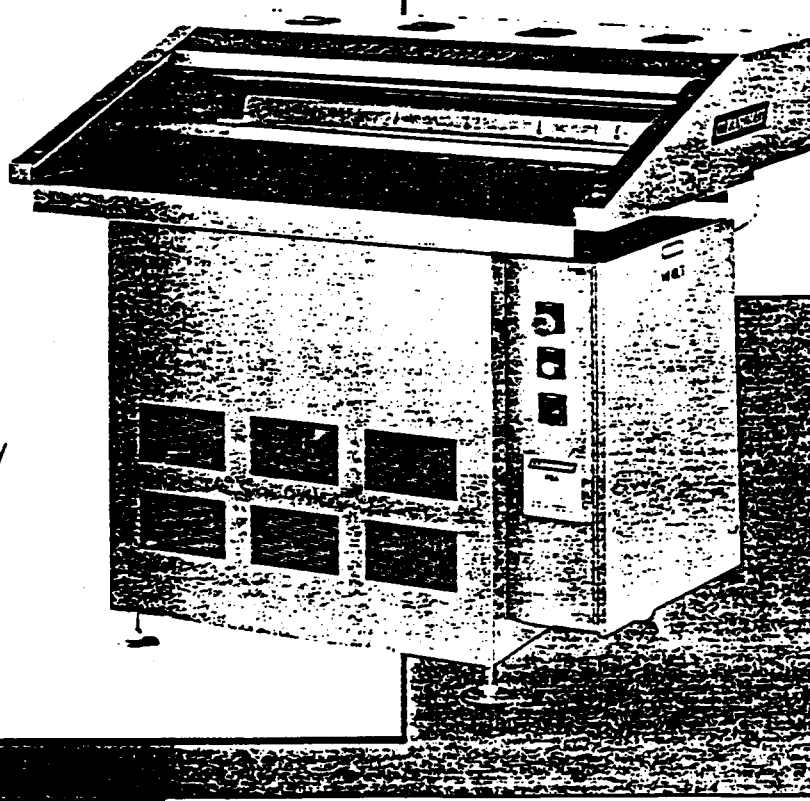

Variable speed conveyor to adjust to your production needs.
Biodegradable. EPA approved cleaning concentrate for oil and contaminant removal.
High pressure spray wash area.
000-watt heater with rmostat.
Emergency shut-off switches for operator safety.
Solution level gauge for easy maintenance.
CLEANOMAT
CLEANOMAT
Adjustable conveyor height – from 29" to 39" from the floor.
Free-wheeling casters allow complete portability within your plant.
Convenient bag-type filter system eliminates need for frequent cleaning of the tank.
Large capacity tank for heavy duty applications.

Dryers

Designed for use in a wet sanding operation, the stand-alone CLEANOMAT dryer features adjustable input height, a variable speed motor, and three sets of polyurethane squeegee rollers and an air knife to remove surface moisture. It is constructed of heavy gauge steel and features either 240 or 480 volt 3-phase power. Optional J.I.C. wiring is also available.

For information about machines capable of custom applications, contact the factory.

Dryer Model No.	Capacity (Width)	Dimensions Length	Width	Height
FSA-25	25"	37"	33"	38" to 41"
FSA-37	37"	37"	45"	38" to 41"
FSA-42	42"	37"	50"	38" to 41"
FSA-52	52"	37"	60"	38" to 41"



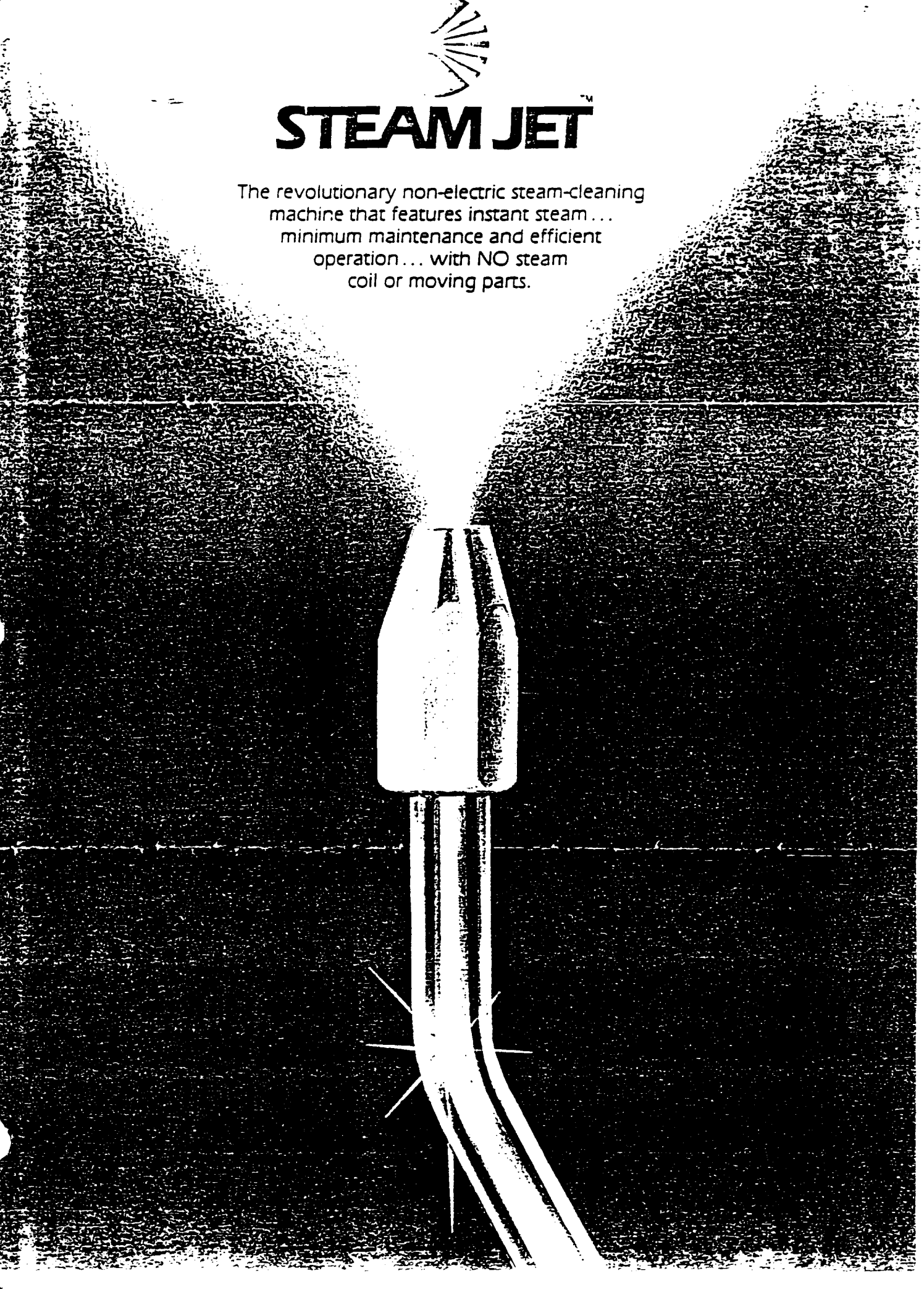
Parts

Should replacement parts be needed for any of your CLEANOMAT washer/dryers or stand-alone dryers, a large parts inventory is maintained for next day air shipment to your facility.

CLEANOMAT

STEAM JET™

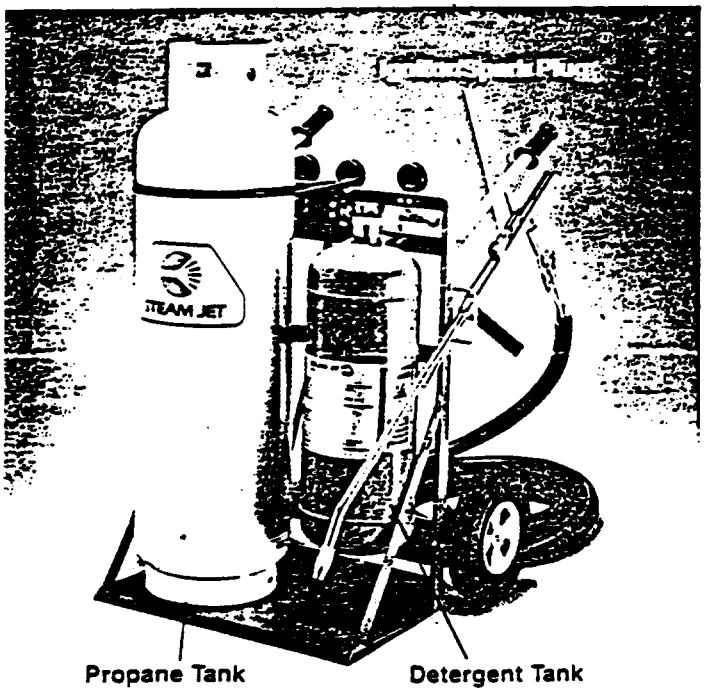
The revolutionary non-electric steam-cleaning machine that features instant steam . . . minimum maintenance and efficient operation . . . with NO steam coil or moving parts.



eam Jet 5 and Steam Jet 3 models are
eal for large and medium duty jobs, such
cleaning industrial machinery and cooling
ills, and degreasing autotruck engines.
nstruction equipment and floors.
SJ-2, a light duty machine, is suitable for
eaning small machinery, lawn mowers, etc.
SJ-3C combines the cleaning power of the
ger SJ-3 with the compact size of the SJ-2.

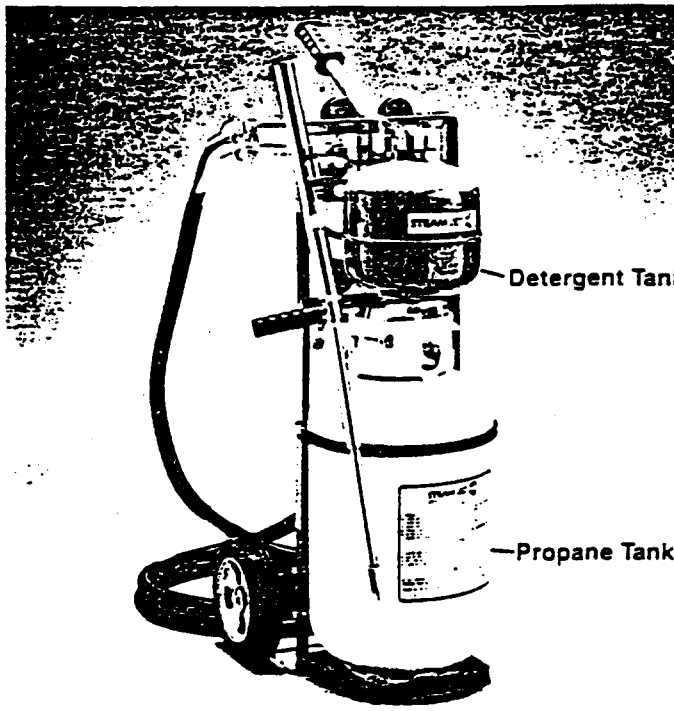
The portable, compact Steam Jet steam-cleaning machines handle just about any job more simply, reliably, and efficiently than conventional systems. Four models range from 1½ to 5 gallons detergent tank capacity, and 65,000 to 175,000 BTU/hr. All are ideally suited for general purpose degreasing and cleaning.

Steam and hot water used in combination with a degreasing solution provide the most effective cleaning method available. And Steam Jet's high-velocity principle eliminates many problems commonly associated with high-pressure washers, such as seal damage, water in electrical systems, hydraulic circuits, etc.



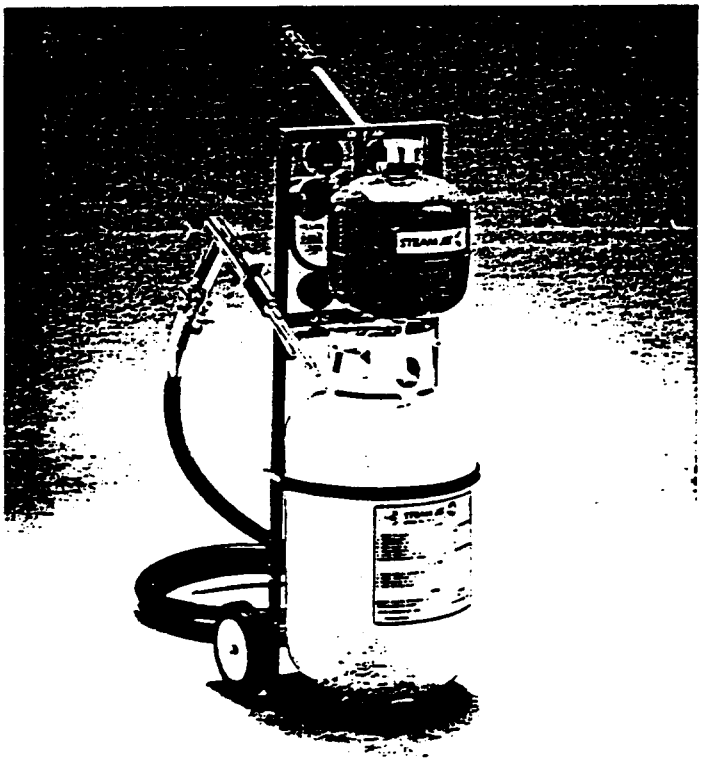
eam Jet 5 (SJ-5)

ergent Tank-Capacity (Gals., approx.)	5	Compressed Air Required @ 60 PSI (CFM)	21
ergent Dispensing System	Pressurized	Gas Consumption—BTU/Hr	8.0
se Assembly—Standard Length (Ft.)	25	Water Consumption/Min -Max. (GPM)	1 to 3
opane Bottle—Capacity (Lbs.)	60	Heat Generation—Btu/Hr	175,000
eam Jet Gun—Type	Rifle	Weight (Dry)—Lbs.	155
n. Water Pressure Required (PSI)	40	Pressure Capacity	Yes



Steam Jet 3 (SJ-3C)

Detergent Tank-Capacity (Gals., approx.)	1½	Compressed Air Required @ 60 PSI (CFM)	
Detergent Dispensing System	Pressurized	Gas Consumption—BTU/Hr	
Hose Assembly—Standard Length (Ft.)	15	Water Consumption/Min -Max. (GPM)	
Propane Bottle—Capacity (Lbs.)	30	Heat Generation—Btu/Hr	10
Steam Jet Gun—Type	Rifle	Weight (Dry)—Lbs.	
Min. Water Pressure Required (PSI)	40	Pressure Capacity	



eam Jet 2 (SJ-2)

ergent Tank-Capacity (Gals., approx.)	1½	Compressed Air Required @ 60 PSI (CFM)	9
ergent Dispensing System	Pressurized	Gas Consumption—BTU/Hr	3.2
se Assembly—Standard Length (Ft.)	15	Water Consumption/Min -Max. (GPM)	1 to 3
opane Bottle—Capacity (Lbs.)	30	Heat Generation—Btu/Hr	65,000
eam Jet Gun—Type	Rifle	Weight (Dry)—Lbs.	55
n. Water Pressure Required (PSI)	40	Pressure Capacity	Yes

Steam Jet 3 (SJ-3)

Detergent Tank-Capacity (Gals., approx.)	3	Compressed Air Required @ 60 PSI (CFM)	
Detergent Dispensing System	Pressurized	Gas Consumption—BTU/Hr	
Hose Assembly—Standard Length (Ft.)	25	Water Consumption/Min -Max. (GPM)	
Propane Bottle—Capacity (Lbs.)	40	Heat Generation—Btu/Hr	10
Steam Jet Gun—Type	Rifle	Weight (Dry)—Lbs.	
Min. Water Pressure Required (PSI)	40	Pressure Capacity	

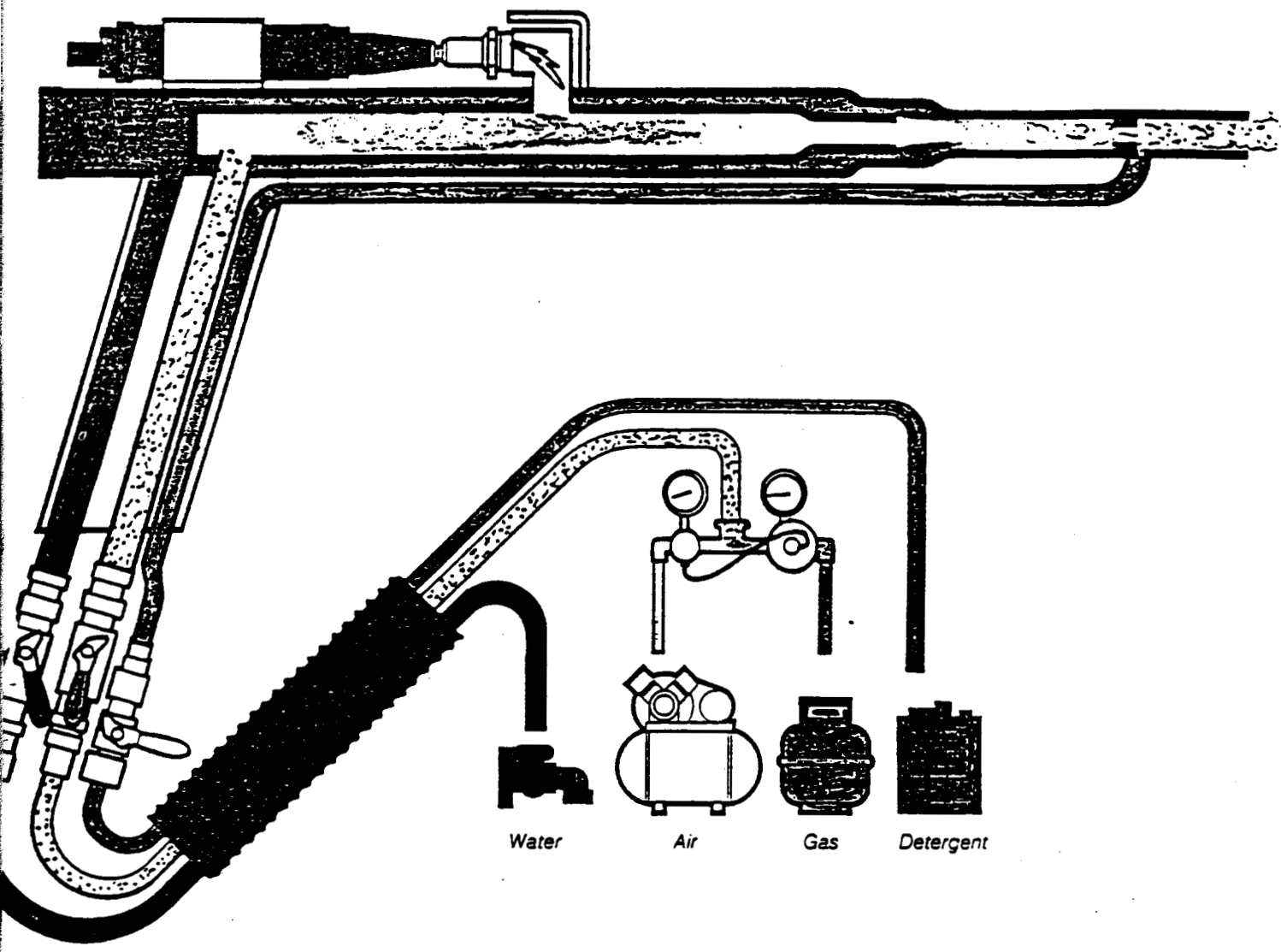
EASY START-UP, INSTANT STEAM, AND FLEXIBLE

Principle components include a detergent tank, an LP gas bottle, and a direct-fired steam gun — all mounted on a two-wheel hand truck. To operate, you simply hook up an outside source of compressed air and water, adjust flow-control valves, push the ignitor button on the gun, and you're producing low-pressure, high-velocity steam that removes grease, grime, and other industrial and automotive contaminants.

NO MOVING PARTS

With no steam coil, motor, pump, or other moving parts, there's almost nothing to go wrong with Steam Jet. It requires no battery or electricity. Maintenance consists of occasionally replacing the spark plug and tightening fittings.

The pressurized detergent system allows the user to presoak equipment being cleaned, emulsifying the grease before steaming.



HOW IT WORKS

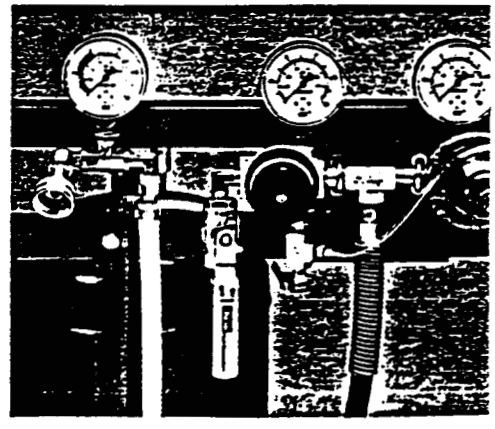
Compressed air is mixed with LP gas in a regulator assembly on the hand truck. The resulting fuel mixture is fed into the combustion chamber of the steam gun. The piezoelectric ignitor is activated by a pushbutton located on the gun. Detergent, which is located in a container on the hand truck, is dispensed into the gun through a pressurized system. Water flows (from a water connection or garden hose) under its own pressure to provide cooling of the gun's combustion chamber. The cooling water is then injected at the down-stream end of the combustion chamber, where it turns into steam. These design features, coupled with UL-approved fuel components and no exposed flame, give the system many advantages over other types of steam cleaners.

EASY TO USE

Steam Jet is so simple that unskilled operators can handle it. All controls — ignition button and flow-control valves for air/gas mixture, water, and detergent — are located on the gun. The unit is labeled with instructions for operation.

STANDARD EQUIPMENT

Hand truck assembly with wheels; detergent tank; hose assembly that includes fuel/air mixture, water, and detergent hoses in a ribbed, protective conduit, DOT-approved propane tank; POL valve/hose (with excess flow protection) that connects propane bottle to regulator; manifold with gauges and regulators for both air and gas, water pressure gauge assembly; piezoelectric ignitor and spark plug with push-button start; and stainless steel gun.



Water, air, and gas regulator assembly mounted on hand truck.

STEAM CLEAN CLEANING SOLUTION

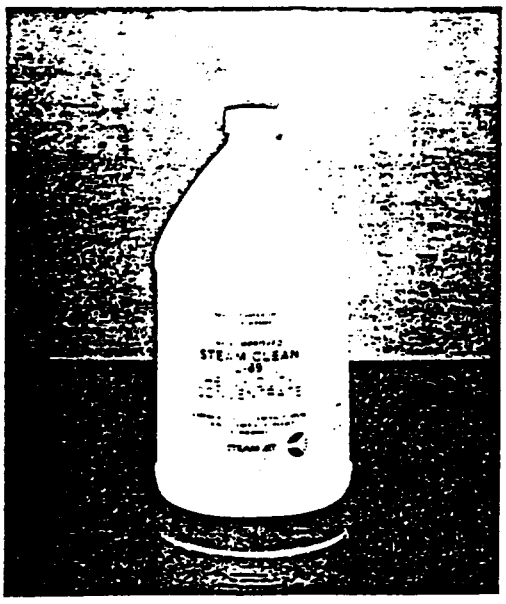
TEAM CLEAN L-89 cleaning
lution is highly effective for
ieral-purpose steam cleaning
nen oil, grease, or dirt are
esent. The solution is specially
rmulated for effective operation
ith the Steam Jet system. The
ombination of heat and high-
elocity makes detergent
tion highly efficient and
conomical — the perfect
ombination for most steam-
eaning requirements.

ACCESSORIES

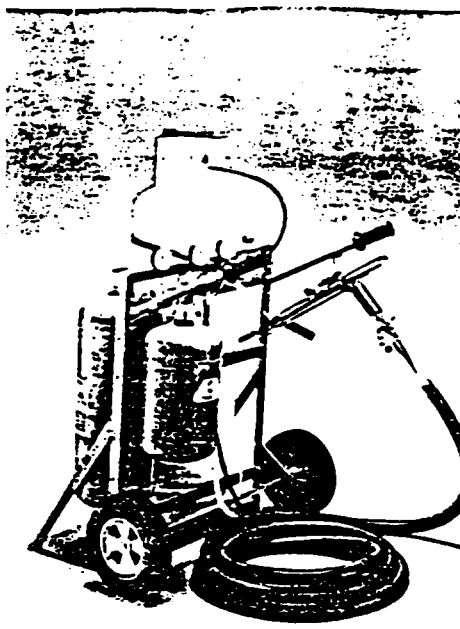
ne *PIGGYBACK OPTION* adds a
cond detergent tank, allowing
e flexibility of switching between
o different chemicals with the
rn of one lever.

TEAM JET BROOM OPTION with
" stainless steel tube is available
r easy cleaning of floors, walls,
id other flat surfaces.

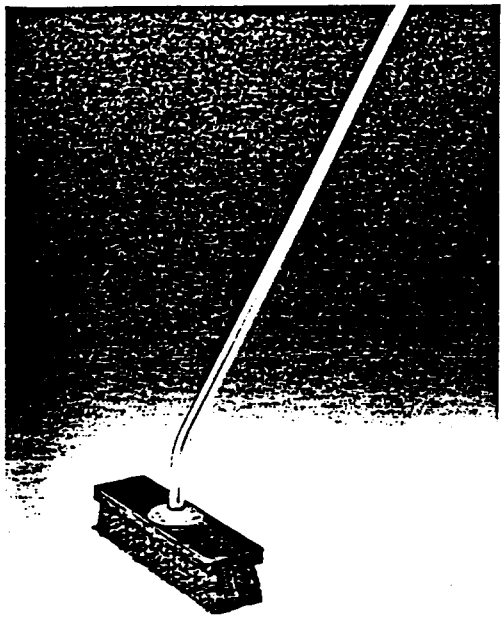
ATER PRESSURE BOOSTER
MP (110 volts) will boost
ssure approximately 10 pounds
er incoming pressure.



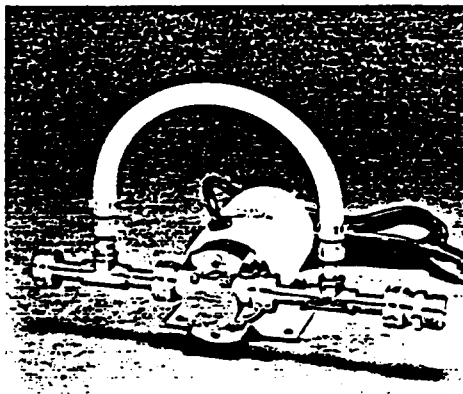
Steam clean L-89



Piggyback option.



Steam jet broom option



Water pressure booster pump.

STEAM JET™

STEAM JET CORPORATION
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Atlanta, GA 30340
Phone 404-452-0001

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If used in accordance with manufacturer's instructions, the complete Steam Jet is warranted for one year against defects in material and workmanship. Any other expressed or implied warranties are excluded. Warranty does not apply to any unit damaged by accident, misuse, or negligence, and does not include liability for consequential damages. See Warranty Card for details.

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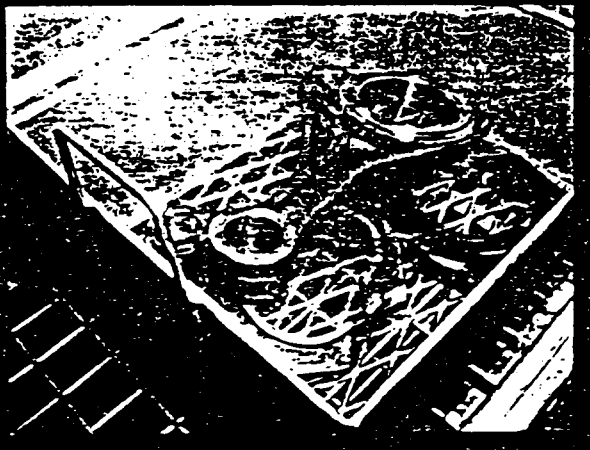
For Industrial Cleaning and Processing



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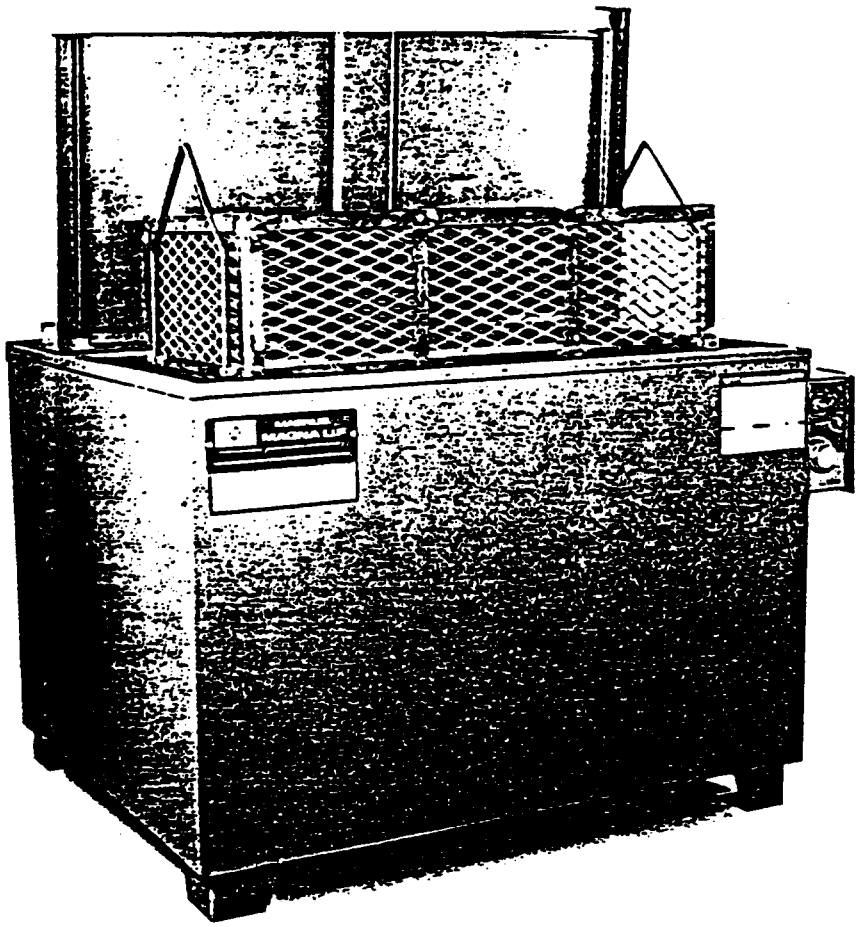
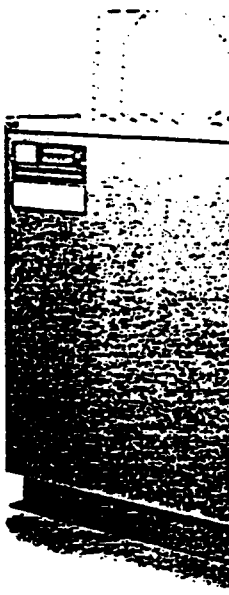


MAGNA LIF SERIES

Available in #3 MALH, #4 MALH, #5 MALH.

- Handles load capacities up to 1,000 lbs.
- Available in mild steel, 304 stainless steel or 316 stainless steel.
- Heated via gas, electric or steam.
- Unheated models also available.
- Agitating platform is cantilever supported from outside the tank.
- DIAL-A-STROKE™ control panel features finger tip control and selection of 3 different stroke lengths.
- AGITATE/SOAK control allows optional modes.



The effective method of cleaning used in Magnus equipment is mechanical agitation. This method is *simply* effective: the equipment moves soiled parts up and down in their cleaning solution - up to 160 times per minute - sheering the dirt from soiled parts.

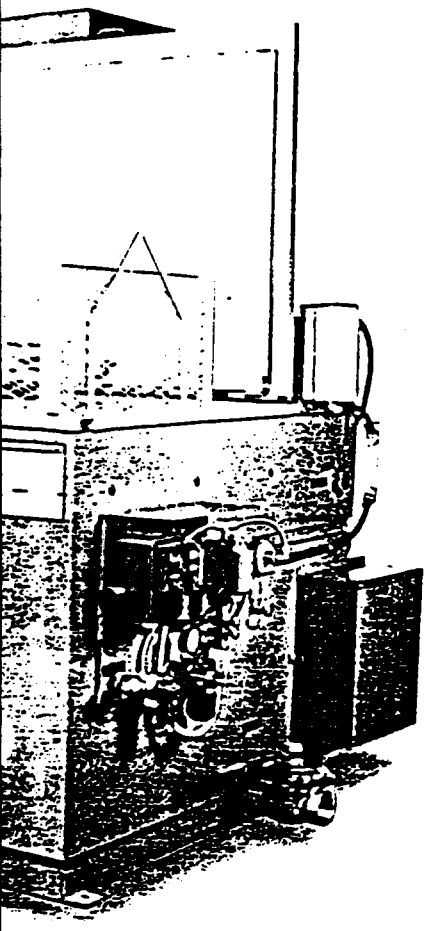
- Use for cleaning, degreasing, decarbonizing stripping, phosphatizing, quenching, pickling and protective coatings.

Alternative to Vapor Degreasers

- Cleans all surfaces, including blind holes and deep recesses, at each vertical motion of the agitation cycle.
- Cleans automatically, freeing employees for other production. Simply load and unload.
- Cleans all materials in either basket loads or, if bulky sized, cleans individually.
- Cleans using most types of cleaning compounds and surface preparation chemicals.
- Roller conveyors can connect individual units for production sequences.
- Pneumatically powered, eliminating the need for electric motors.

-LA LIF SERIES

- ...ilable in #1 ALNH, #4 ALNH, #6 ALNH.
- Handles load capacities up to 2200 lbs.
- Available in mild steel, 304 stainless steel or 316 stainless steel.
- Heated with gas, electric or steam
- Unheated models also available
- Single control for up, down and agitate modes.
- Selection of three separate stroke lengths.



MIJI _

Avail...
Model...
Model...

- Han... ties up...
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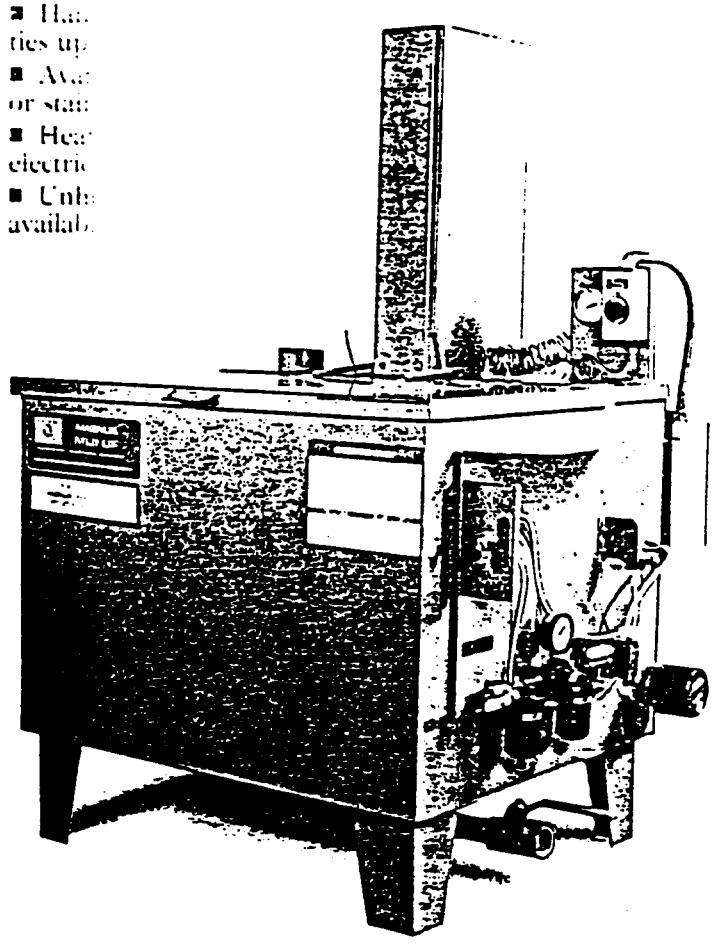
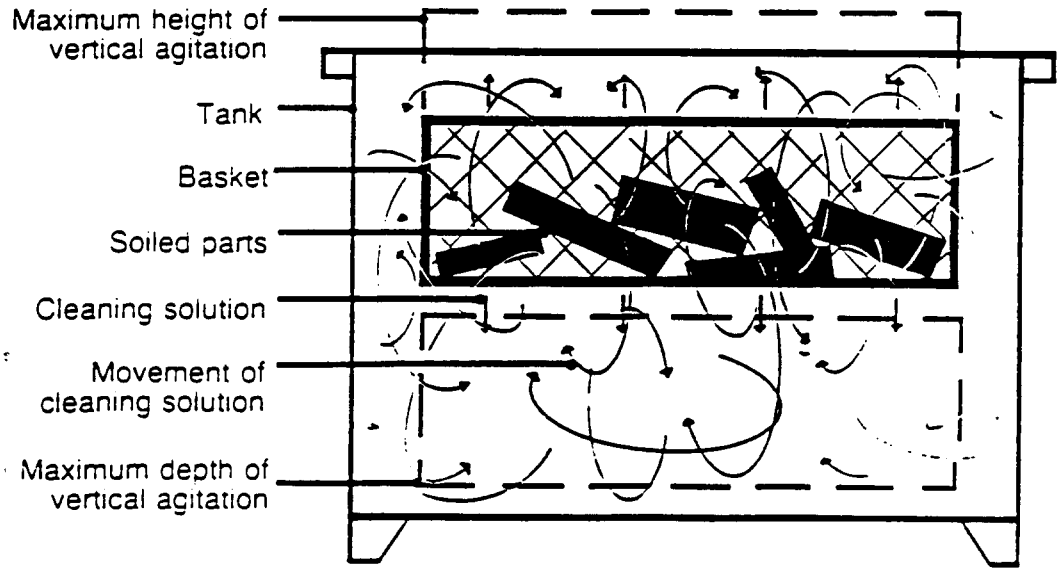
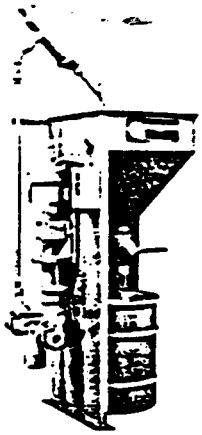




The Principle of Mechanical Agitation

Magnus equipment uses mechanical agitation for metal surface preparation. Soiled loads are secured on a platform or in a basket. The proper speed and cycle for agitation is selected. The load is then mechanically agitated, swirling cleaning solution to all surfaces, until the load is clean.

Magnus Ancillary Equipment



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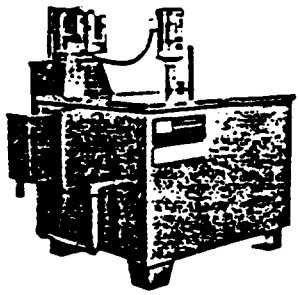
CYCLONIC FILTER

The Magnus Cyclonic Filter System is a self-contained unit which will remove up to 98% of most suspended solids, down to 5 microns. from both aqueous and solvent cleaning solutions. Available in:
240V/3ph/60Hz
480V/3ph/60 Hz



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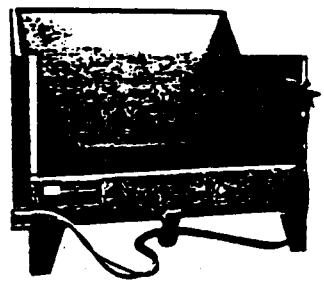
OIL SKIMMER

The Magnus Oil Skimmer is a self-contained unit designed to effectively remove floating oils and scum from the solution surface of cleaning tanks.
Available in Model H and Model XH.

- Maximum capacity for Model H:
  Steel parts - 1,000 lbs.
  Aluminum parts - 327 lbs.
- Maximum capacity for Model XH:
  Steel parts - 2,200 lbs.
  Aluminum parts - 718 lbs.
- Both models available in:
  120V/240V/1ph/60Hz
  240V/480V/3ph/60Hz



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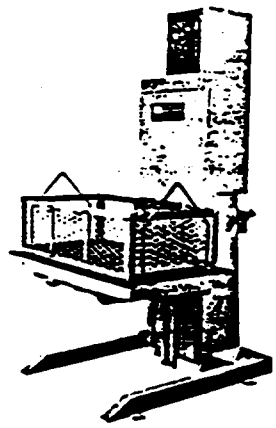
RINSE BOOTH

The Magnus Rinse Booth is a manual air/water pressure rinsing system. All Rinse Booths are equipped with the Hydro Air Rinser. Available in Model 60 and Model 84.



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LOAD LIF

The Magnus Load Lif accepts basketed work from a plant conveyor system and discharges at a height as low as 6 3/4" and as high as 43 7/8". Available to match the MALH SERIES of cleaning machines.

Magnus Equipment Options and Accessories

Available for the MAGNA LIF, AJA LIF, and the MIJI LIF series.

- Parts baskets for each size machine.
- Roller platform (instead of grate platform).
- Connecting sections of roller conveyor between machines.
- Load and unload sections of roller platforms.
- Seven day heat programmer. (Not available on MIJI LIF SR with electric heat).
- Automatic cycle timer. (Not available on MIJI LIF SR unless equipped with a stroke selector).
- Heater Guardian for electric heated machines.

In addition to these equipment features, Magnus equipment insures quality performance and long service life plus the Man-Gill promise of reliability and dedicated service.

For more information, call our toll free number:

1-800-328-9745

Man-Gill Chemical
23000 St. Clair Ave.
Cleveland, OH 44117

100/0200/0188

CATALOG 100

RAMCO

MO-KLEEN

RAMCO MIGI-KLEEN PARTS WASHERS

Modern Parts Washing Systems and the Environment

Health, safety and environmental regulations are redefining the workplace. It's a sign of the times and a signal to all progressive thinking manufacturers and rebuilders. Toxic chemicals and hazardous waste must be eliminated. And the sooner the better.

Of major concern are traditional vapor degreasing and cleaning solvents. The potential health effects and ecological consequences of these toxic solvents are well documented in EPA, medical and scientific studies.

Ramco has manufactured washers and degreasers for over 60 years. At Ramco we are in the business of finding and creating safe solutions for the future. Our goal is to provide the best possible parts washing systems for our customers. We believe that personal health, safety and the environment come first and there can be no compromise or question when it comes to safeguarding these areas. Our modern parts washing systems are designed to use mild biodegradable cleaning agents and still meet demanding cleanliness specifications. They can replace existing toxic solvent degreasers and achieve equal to or better results in most applications.

Typical Applications

- Removal of lubricants and chips from machined components, castings and housings.
- Cleaning prior to welding, deburring, blasting, phosphating or assembly.
- General washing for maintenance, rework and/or remanufacturing.
- Carbon, rust, ink, and paint removal.

Easy to Operate

Migi-Kleen does the dirty work. It completely eliminates the need to clean parts by hand. The transport elevator automatically processes the work. Labor is saved for more skillful operations.

1. The operator loads contaminated parts or basket(s) of parts onto the sturdy transport elevator.
2. Flip a switch, the elevator automatically lowers the work into the immersion chamber and reciprocates, up and down, up to 240 strokes per minute.
3. Vigorous mechanical agitation swishes solution against all surfaces, in and around holes and recesses. Stubborn contaminants are washed away with complete ease and without hand labor. The operator returns at his/her convenience, flips the switch and the transport elevator rises to the original loading position.

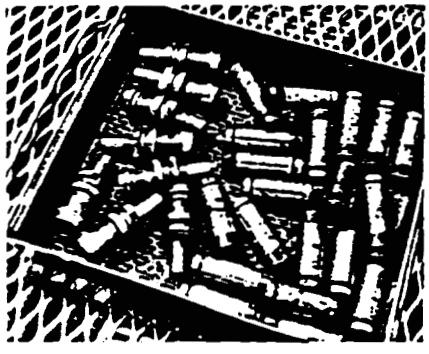
Migi-Kleen The "Innovative Parts Washer"

Migi-Kleen is an immersion parts washer designed for the removal of oils, chips, and dirt from a wide range of components. It accomplishes this using a simple and rugged pneumatically powered reciprocating platform. The immersion chamber is built to adapt a variety of auxiliary items, as required by the application, to heighten the chemical and/or mechanical activity of the cleaning solution.

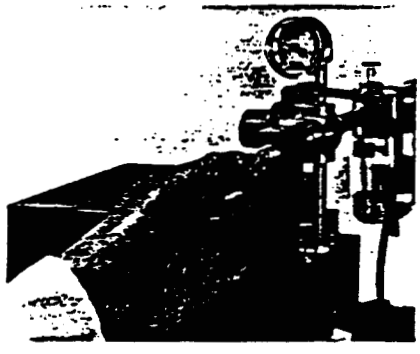
Ideal for Cellular Cleaning

Migi-Kleens take up a minimum of floor space and accommodate a wide assortment of component sizes and configurations. Furthermore, a broad spectrum of cleanliness levels can be satisfied. Starting with the basic modular system you can integrate additional agitation apparatus and/or effluent controls to meet your requirements. From general washing to precision cleaning, Migi-Kleen does it all.

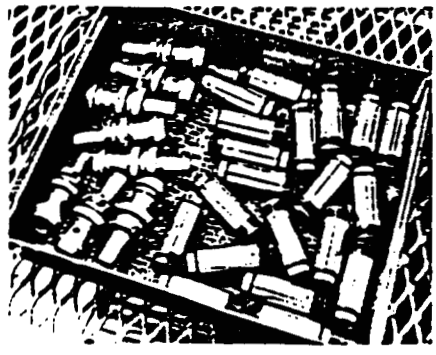
1. Load

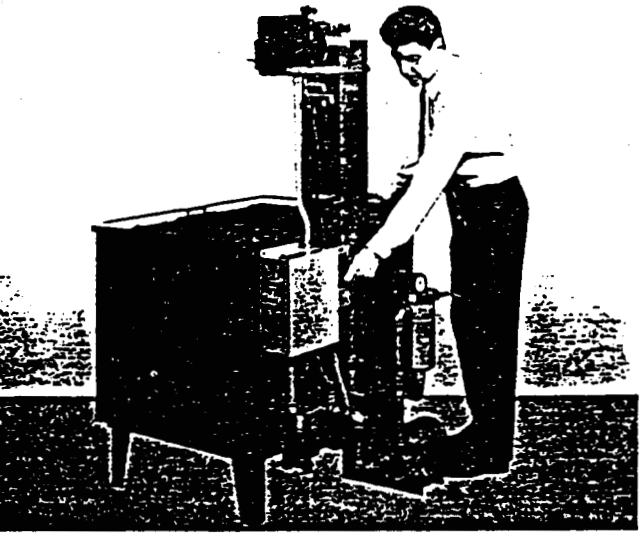


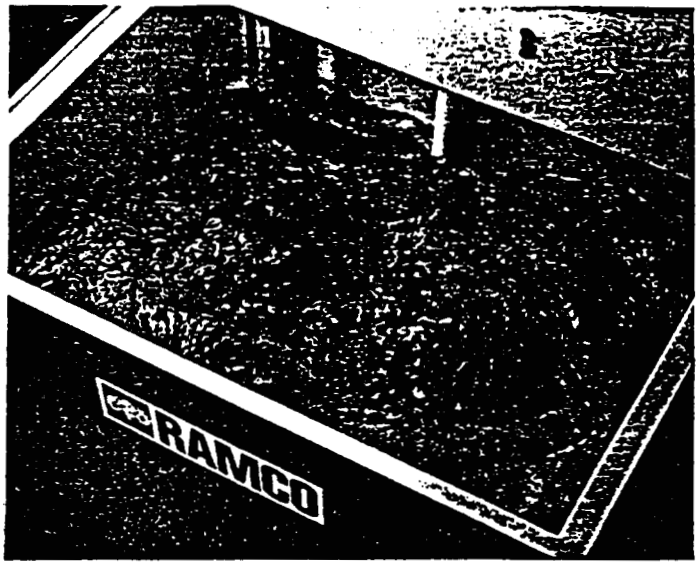
2. Flip a switch



3. Unload







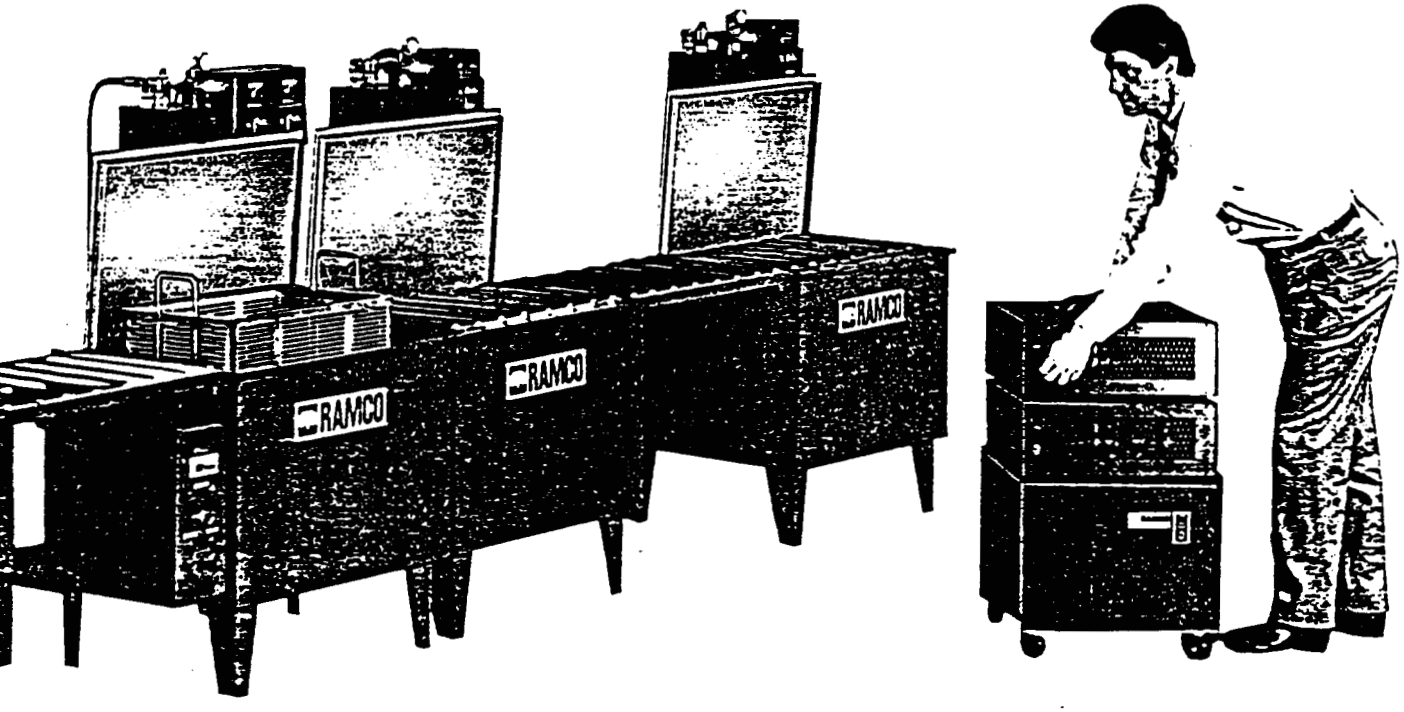
ter Turbo Combinations

ssortment of "bath conditioning" apparatus can be added he basic system. **Turbulating systems** use high volume ps and closed looped manifolds with multiple solution ctors directed at the work zone. They provide an even flow rbulance over, under, around and through components. accelerates the cleaning time and improves overall ctiveness in washing and/or rinsing.

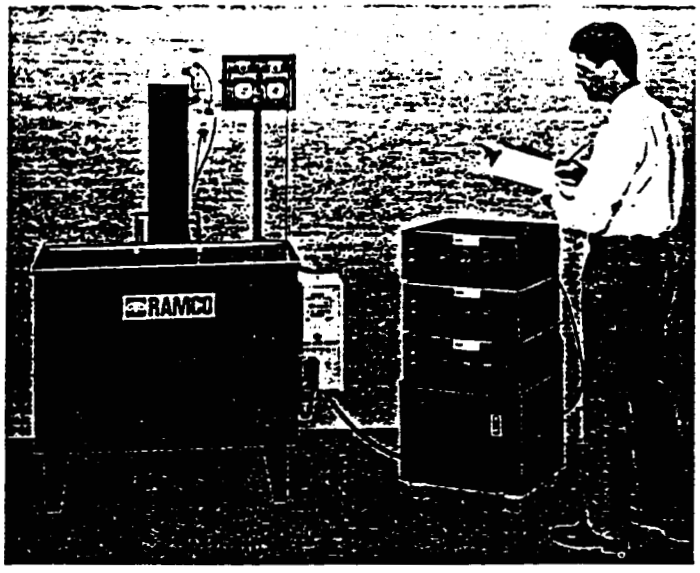
r **turbo combinations** include a high performance filtration in line with the turbulator to remove suspended culate. Single and dual housing systems with mesh, cartridge or bag filter elements are standard. Low micron and absolute filtration systems are readily available.

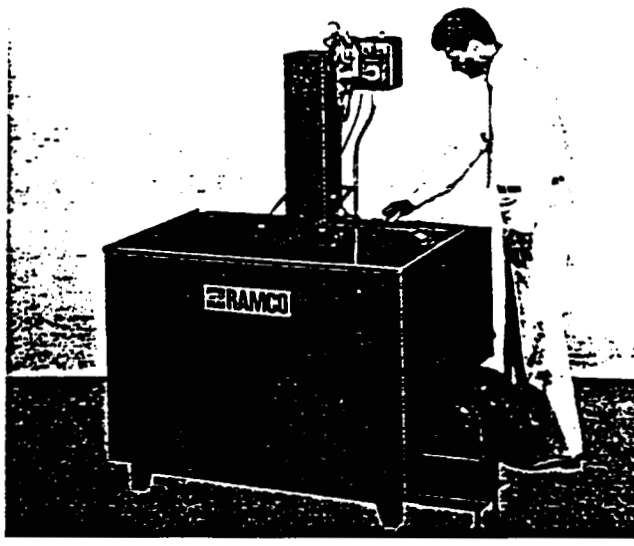
Compact oil removal systems use several types of oleophilic belts, relative to the application, for skimming tramp oil that rises to the surface. Built-in and stand alone units are available depending on the quantity of oil to be removed and degree of cleanliness required.

Migi-Kleen effluent control systems **actually** clean the solution while the solution cleans your parts.



ve semi-automatic cleaning line has pre-wash, rinse, ultrasonic wash, rinse, and rust inhibitor stages.





Ultrasonic Migi-Kleens

Integrating the basic reciprocating platform with Ramco High Intensity Ultrasonics (see Catalog 300) produces a unique dual mode washing station. Multiple transducerized enclosures (immersibles) positioned within the immersion chamber are driven by powerful solid state generators. Each generator is independently wired to a specific immersible. A remote mobile pedestal is provided for stacking, protecting, and energizing the generators.

The system creates an intense microscopic scrubbing action and a significant boost in chemical activity. It can penetrate recessed areas of intricately shaped components to loosen fine and tenacious contamination.

Variable preset timers are used to control each cycle with ultrasonic cleaning followed by agitation washing. A selector switch is included for semi-automatic (independent ultrasonic and agitation) of automatic (cascading) modes. Additional standard features include electric heating system, insulation package, and digital indicating temperature controller.

Ultrasonic Migi-Kleens are very effective when used in applications with demanding cleanliness specifications.

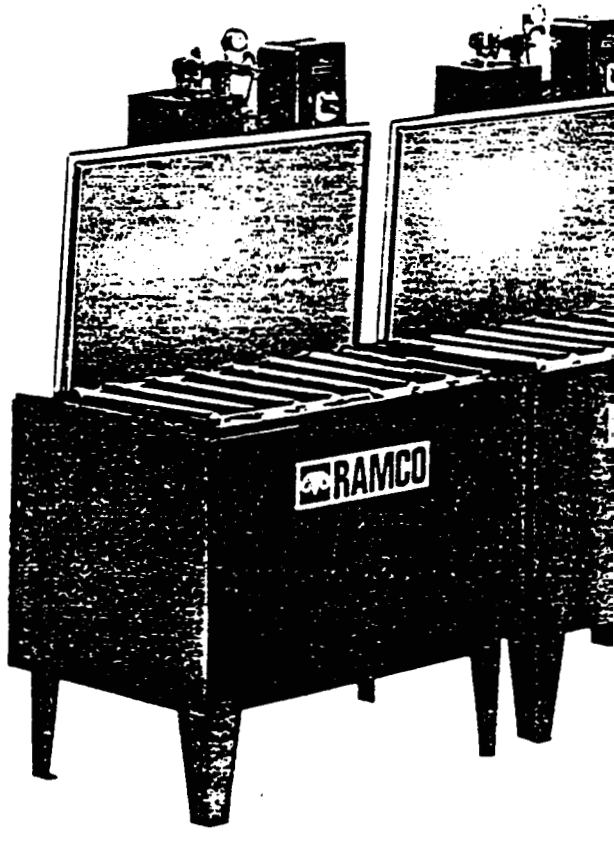
Migi-Kleen Dryers

These compact stainless steel dryers are fully insulated designed for batch loading after washing or rinsing. system uses forced hot air directed around and bet components. The standard Migi-Kleen transport ele facilitates loading and unloading of the drying chamber gently oscillates the work throughout the cycle. This enha the processes by jogging off droplets and constantly char air flow patterns within the chamber. Standard features inc automatic timing and digital indicating temperature contr

Migi-Kleens are Expandable

Due to their compact modular design, Migi-Kleens can grow to meet your changing requirements. You can budget according to your current needs adding features and/or stations if and when required. For example, a basic wash system can be retrofit with turbo filter to increase productivity or a rinsing station added to improve cleanliness. As specifications tighten your system can adapt. Migi-Kleens can be placed side by side without the use of connecting sections. This significantly reduces floor space requirements. Elevator platforms can be equipped with roller conveyor sections to facilitate manual transfer from station to station.

Fully automated systems incorporate a versatile power feed conveyor and a microprocessor controlled drive mechanism. The cleaning system consists of individual Migi-Kleen stations equipped with agitation apparatus and effluent controls as required. The feed system automatically spaces inbound baskets. The drive mechanism smoothly, accurately and simultaneously transfers multiple baskets from station to station. Automatic covers open/close in sequence with the programmed cycle.



MIGI-KLEEN FEATURES

Migi-Kleen includes the following standard features:

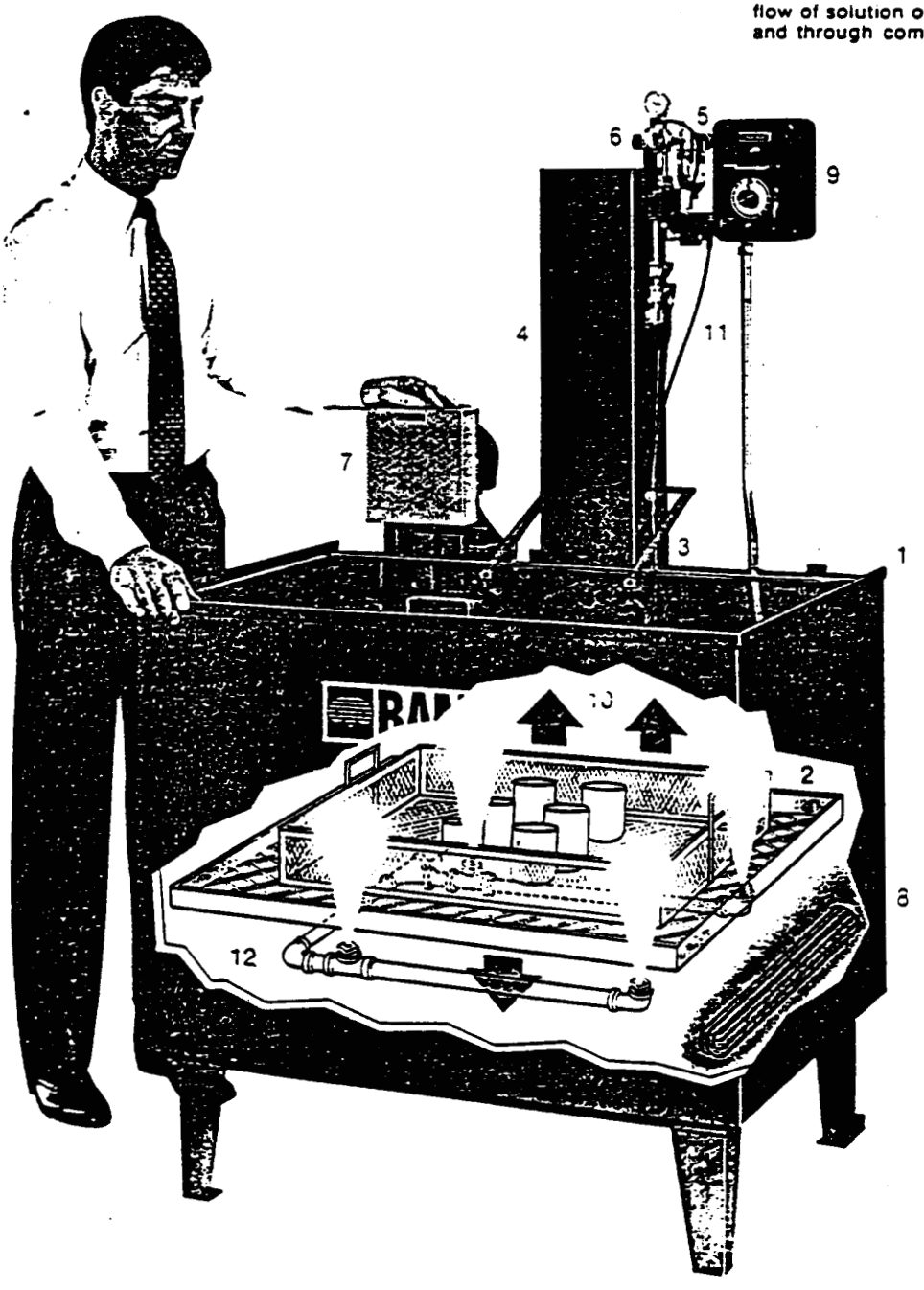
1. Heavy gauge steel construction with flange up solution drip lip.
2. Sturdy transport elevator with no internal bearings.
3. Hinged splash guard cover with fusible safety link.
4. Safety guard to enclose moving parts.
5. Air line filter, regulator, and lubricator.
6. Single switch control.

Optional features to enhance enhance efficiency and overall cleanliness:

7. Compact oil removal unit skims off tramp oil that rises to the surface.
8. Electric heating system provides rapid heat-up and controlled solution temperatures up to 250°F.
9. Preset timer precisely controls overall cleaning cycles.

Exclusive Migi-Kleen *dynamic flow combinations* to significantly improve cleaning performance:

10. Standard reciprocating platform provides vigorous mechanical agitation up to 240 strokes per minute.
11. Dual stroke control — rapidly reciprocating short stroke for general cleaning or long stroke, in and out of solution, for flushing blind holes.
12. Turbulation manifolds with multiple injectors directed precisely at the work zone distribute a high volume flow of solution over, under, around and through components.



Specifications

Dimensions	MK-30	MK-36	MK-48
Tank Inside:			
Length A	30"	36"	48"
Width B	22"	26"	26"
Height C	21"	27"	27"
Dipping Space:			
Length D	29"	34"	46"
Width E	18"	21"	21"
Height F	13"	18"	18"
Overall Tank:			
Length G	33"	39"	51"
Width H	23½"	28"	28"
Height J	31"	36"	36"
Overall Machine:			
Length G	33"	39"	51"
Width L	28½"	34"	34"
Height M	57"	68"	68"
Work Platform:			
Length D	29"	34½"	46½"
Width E	18"	21"	21"
Roller Platform:			
Total Length D	28"	34"	46"
Roller Width E	17"	21"	21"
Solution Level: (above tank bottom)			
Height N	16"	22"	22"
Liquid Capacity:			
Gallons	40	90	120
Load Capacity:	150 lbs.	150 lbs.	150 lbs.

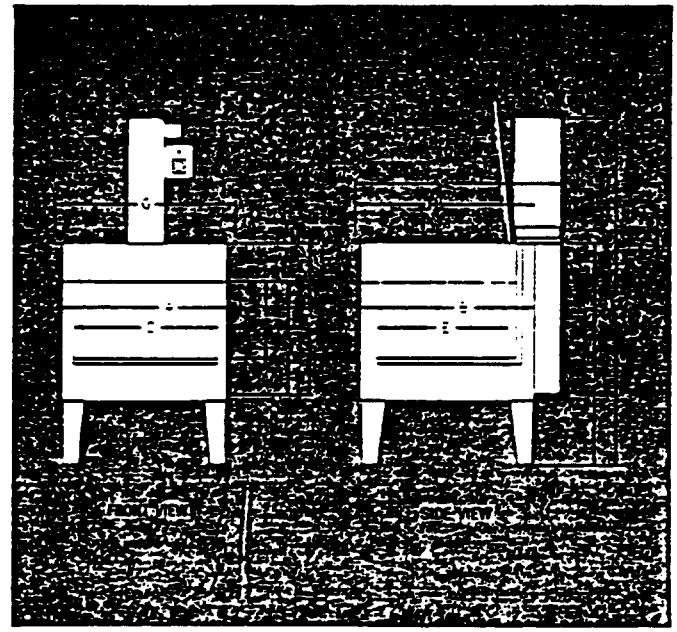
Dimensions	MK-30	MK-36	MK-48
Tank Gauge	13 Ga	12 Ga	12 Ga.
Shipping Weight: Pounds	210	450	490
Basket: Dimensions: Inside Dimensions:			
Length	24"	30½"	42½"
Width	13½"	17"	17½"
Height	6"	8"	8"
Heating Data: (4)			
Electricity	6KW	9KW	9KW
240-1-60	26 amps.	37.5 amps	37.5 amps
240-3-60	14.4 amps	21.5 amps	21.5 amps
480-3-60	7.2 amps	11 amps	11 amps
Average heat up time from room temperature to 180°F.	2 hours	3 hours	4 hours
Service Facilities:			
Drain Valve	1"	1"	1"
Overflow	1"	1"	1"
Air Inlet	¼"	¼"	¼"
Water Inlet	¾"	¾"	¾"
Air Supply	30-125 psi	30-125 psi	30-125 psi
Air Consumption	2 to 4 CFM	3 to 5 CFM	3 to 5 CFM
Agitation Data:			
Stroke Length	2" to 4"	—	—
Short Stroke	—	2" to 4"	2" to 4"
Long Stroke	—	5" to 9"	5" to 9"
Up and down motions per minute	40 to 240	40 to 240 (short stroke) 30 to 70 (long stroke)	40 to 240 (short stroke) 30 to 70 (long stroke)

Options

1. Baskets
2. Roller conveyors (load, unload, platform)
3. Automatic cycle timer
4. Seven day program timer
5. Digital indicating temperature controller
6. Automatic covers
7. Heating systems (electric, steam, gas)
8. Filtration systems (low and high volume, absolute)
9. Turbulating systems
10. Oil removal systems
11. Filter turbo combinations
12. Tumbling trunion fixture
13. Ventilation ducts and complete exhaust systems
14. Rinsing units

Notes

1. The engineering data above are typical and may vary with air pressure, weight load, and part configuration.
2. All tanks, covers, baskets, roller conveyor sections, steam coils, gas coils, turbulation manifolds, pumps, piping, filter housings, ventilation ducts and blowers are available in carbon steel or stainless steel construction.
3. Electric heating units include fully immersed stainless steel sheathed elements. MK-30 heating system includes thermostatic control with off position, indicating pilot light, and six foot line cord. MK-36 and MK-48 heating systems include thermostatic control with off position, master control panel with 110 volt step down transformer, on/off control switches and indicating pilot lights.
4. Insulation package included on heated models MK-36 and MK-48, optional on heated model MK-30.
5. Other standard agitating parts washers (with load capacities up to 2000 pounds) and turbulating parts washers (with unlimited load capacities) are available. Ask for Catalog 200.



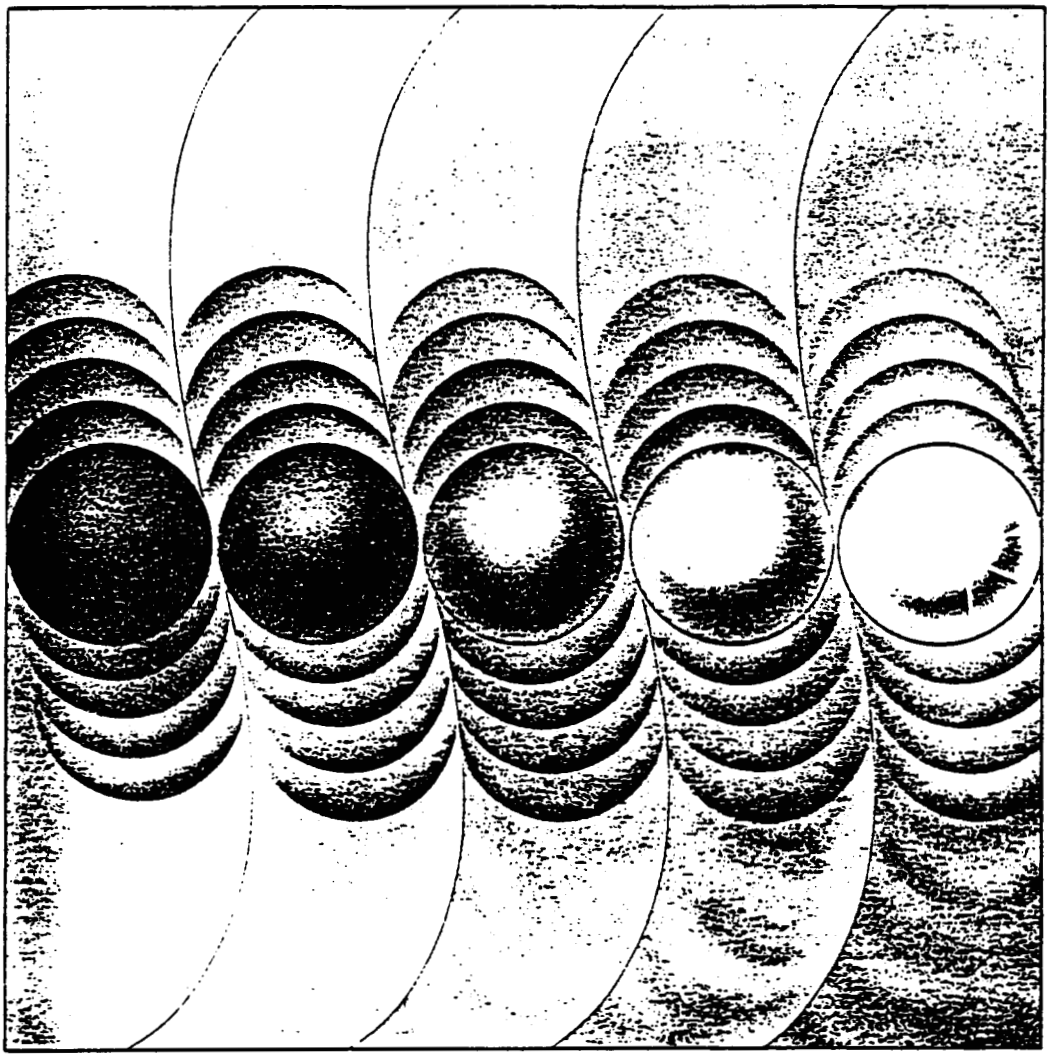
RAMCO
32 MONTGOMERY STREET, HILLSIDE, NEW JERSEY 07205
TEL: 201-687-6700 FAX: 201-687-0653

CATALOG 200

RAMCO

AJA-KLEEN PARTS WASHERS

FOR INDUSTRIAL APPLICATIONS REQUIRING HIGH PERFORMANCE CLEANING



AJA-KLEEN SERIES
VECTOR SERIES

32 MONTGOMERY STREET
HILLSIDE, NEW JERSEY 07205
TEL 201-687-6700
TELEX 833231 RAMCO
FAX 201-687-0653

Introduction to Ramco Parts Washers

In selecting a parts washing system it is important to consider the size, shape, and configuration of the parts themselves. Massive weights, large surface areas, acute angles, occluded sections, and blind holes can pose special problems, independent of the contaminant to be removed or the chemical cleaner to be used. Proper cleaning of all parts can only result when consideration has been given to these physical variables.

Furthermore, there are several washing methods available today. These are:

a. mechanical agitation

b. solution turbulation

c. cavitation and,

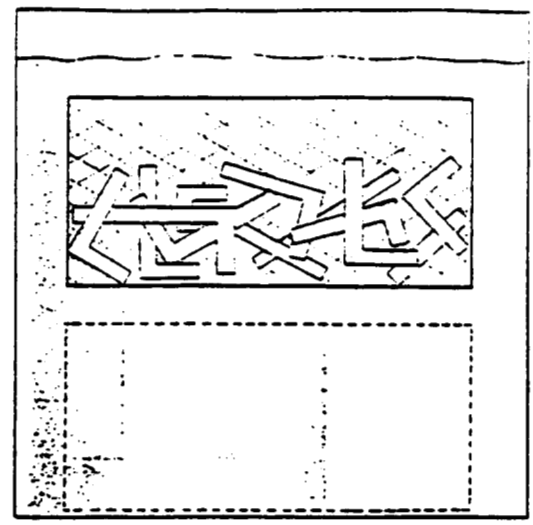
d. high pressure water.

Each method has a special set of cleaning characteristics which can be used to solve specific problems.

In this brochure we will address mechanical agitation and solution turbulation.

the facts about mechanical agitation and solution turbulation

The simplest way of covering irregular surfaces and reaching intricacies and the inside of hollow forms with a cleaning solution is by immersion. Agitation of the work in the solution or of the solution in and around the work is a means of accelerating the cleaning action. With agitation the mechanical force of the moving solution keeps washing newly formed emulsions and soaps away from surfaces while applying fresh chemical cleaning agents to the newly exposed layers of dirt, thereby speeding the entire action.

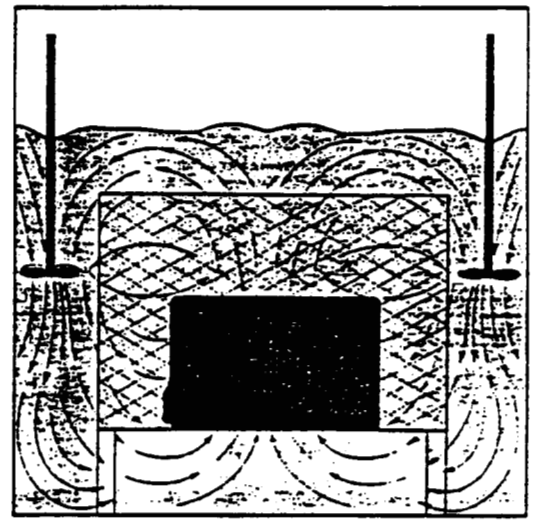


MECHANICAL AGITATION

Cleaning Characteristics

1. complete immersion
2. recessed areas in contact with solution
3. parts moved up and down
4. vertical motion swirls solution against surfaces dispersing the contaminants.

This is the most common method of batch washing parts.



SOLUTION TURBULATION

Cleaning Characterisitcs

1. complete immersion
2. all recessed areas in contact with solution
3. high velocity agitation of solution around and through the parts.
4. shearing action strips away contaminants from the surfaces.

Ramco Vector Washers are designed for cleaning operations where violent solution movement is desired. This is the preferred method for immersion cleaning of massive components or where batch loads are routinely very heavy.

The Ramco Controlled Motion (CM) Aja-Kleen System is engineered for selective movement of parts in the cleaning bath. By combining variable lengths of stroke with variable speeds of stroke an infinite number of motion combinations can be created to handle many different cleaning problems.

Ramco Aja-Kleen Washers are without a doubt the most rugged mechanical agitation systems built. The tanks are made of heavy guage steel. Structural channel is used for the elevator and guide rails. The pneumatic system is extremely reliable and durable yet very easy to operate and maintain.

FEATURES

Aja-Kleen Washers are engineered with the end user in mind. This viewpoint is seen in the many standard features and advancements designed into each unit.

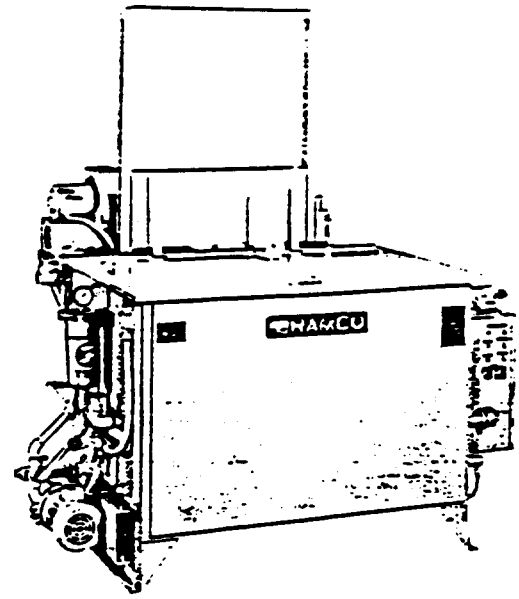
RAMCO CONSTRUCTION

Each system is built using structural channel with a minimum 3/16" (1/4" on large models) steel plate rear wall. Heavy duty guide rollers are mounted in six critical locations to provide smooth, durable tracking and a jam proof elevator. The outer tank lip is flanged and raised to trap solution and minimize spillage onto exterior walls. The interior cover is epoxy coated to prevent rusting.

J.I.C.* CYLINDERS AND PNEUMATIC COMPONENTS

Special "factory only" cylinders and components can become a problem in maintaining your machine. Frequent "Maintenance Kits" are required to keep you up and running. Ramco uses only J.I.C. cylinders and components to provide the highest reliability and broad interchangeability with the many standard brands in the industry. Our design virtually eliminates cylinder wear for years of trouble free service.

*J.I.C. — Joint Industrial Conference, an established source of standards for pneumatic components.



THE RAMCO PNEUMATIC CIRCUIT

Built for reliability and versatility, the Ramco pneumatic circuit is the best in the industry. Speed and stroke controls are variable with agitation speeds up to 400 strokes per minute. An air filter, regulator and lubricator is included with every system. The overall simplicity in design makes maintenance an easy job.

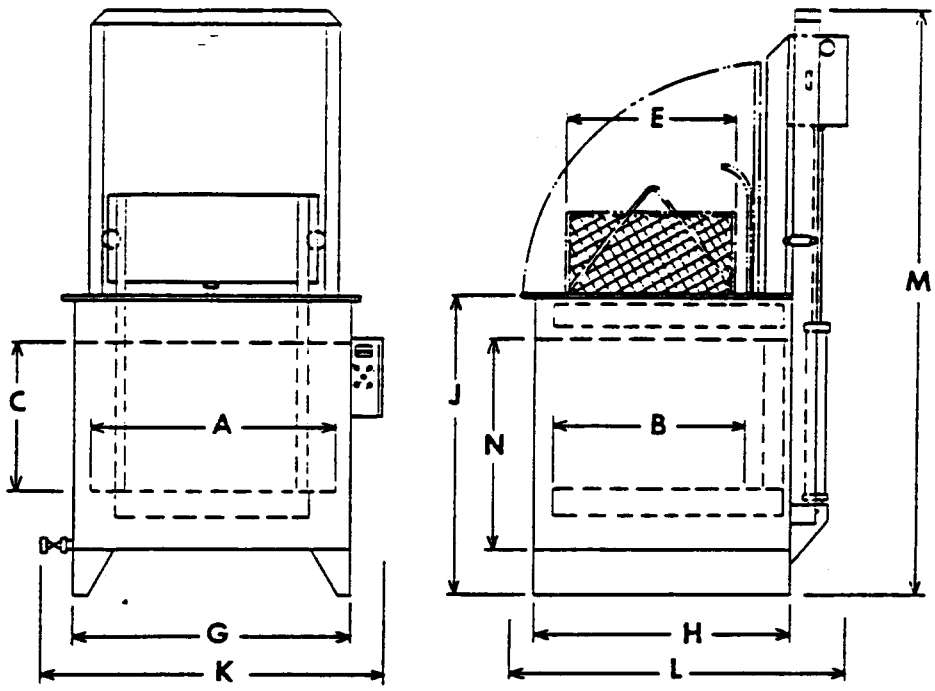
AUTOMATIC OPENING/ CLOSING COVERS

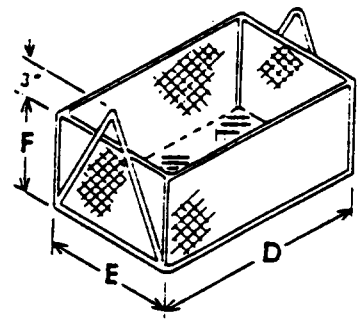
Manual (counter-balanced or spring loaded) covers can be left open causing loss of heat and chemical as well as increasing the chances of solution splashing out of the tank. Aja-Kleen Washers include automatic opening/closing covers on every unit to ensure cleaning safety and economy.

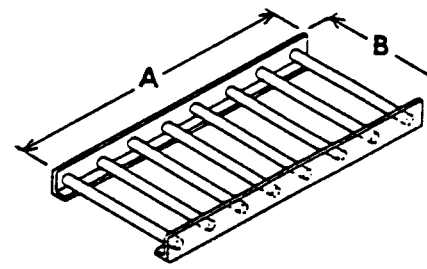
OTHER STANDARD FEATURES

Aja-Kleen heated systems are fully insulated. They come with indicating temperature controllers.

Every electrical panel has a 110 volt control circuit for safety. Included are indicating pilot lights, heater on/off controls, stand power on/off controls, and split load wiring for energy savings. All electric heaters are stainless steel.







AJA-KLEEN MODEL	WORK SPACE			BASKET DIMENSIONS			TANK DIMENSIONS			OVERALL DIMENSIONS			TANK		HEATING				AIR CONSUMPTION LOAD CAPACITY				SHIPPING	
	A	B	C	D	E	F	G	H	J	K	L	M	N	Gal.	STM. 1	GAS 2	ELEC. 3	AMPS 460	c.f.m. 4	c.f.m. 5	lbs. 4	lbs. 5	lbs.	cu. ft.
CM36	33	25	20	32	24	12	36	36	41	52	46	78	29	165	50	75	15	19	6	12	500	1000	750	130
CM48	45	31	20	44	30	12	48	42	41	66	52	78	29	255	65	100	18	22	12	24	500	1000	1000	175
CM60	57	31	27	56	30	16	60	44	50	78	54	95	39	445	115	175	36	45	24	48	1000	2000	1350	240
CM72	69	37	27	68	35	16	72	48	50	92	60	95	39	585	160	240	48	60	24	48	1000	2000	1650	325

NOTES

1. steam at 15 p.s.i., pounds per hour
2. gas cubic feet per hour
3. electric kilowatts
4. regular load
5. heavy duty load
6. 80 p.s.i. air pressure required
7. other sizes available on request

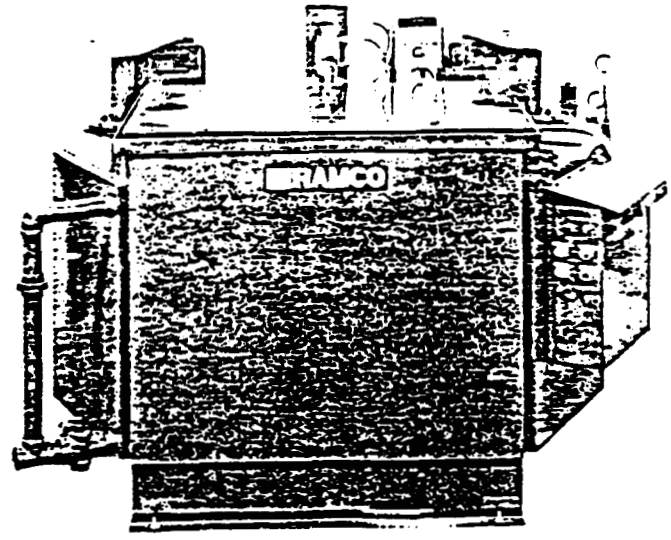
AJA-KLEEN OPTIONAL EQUIPMENT

1. filtration, cartridge type ✓
2. filtration, cyclonic
3. oil skimmer overflow
4. automatic oil removal system
5. lip vent exhaust system
6. baskets
7. fusible safety link
8. load, platform, and unload conveyors
9. stainless steel construction
10. automatic cycle timer
11. 7 day program timer
12. solution low level safety control

VECTOR SERIES

Vector washers are engineered specifically for tough cleaning jobs. Designed for maintenance shop environments these units provide intense turbulance of massive volumes of solution, which impacts against parts to scrub away contamination. Heavy loads are no problem. The tanks are made of heavy guage steel construction. All units incorporate power operated covers for easy handling.

Our Whirljet Agitation System is the most dependable and versatile turbulating system built. It uses top entry agitators to eliminate any possibility of mechanical seal failure.



FEATURES

Made for tough jobs and tough environments Vector Washers are designed with all these standard features:

RAMCO WHIRLJET AGITATION SYSTEM

Ramco Whirljet Agitators provide maximum turbulance per horsepower. We achieve this efficiency by accurately balancing RPM with prop diameter to obtain optimum solution turnover.

The Whirljet Agitation System is a definite advancement over the old side entry construction.

Whirljet Agitators are top entry designed. The motors and drive mechanisms are remote and out of the solution area. Mechanical seal failures and solution damage to motors are completely eliminated. The entire assembly can be pulled for maintenance without having to drain the tank.

RAMCO CONSTRUCTION

Each Vector is fabricated of a minimum 10 gage steel on smaller models and 1/4" steel plate on larger models. The outer tank lip is flanged and raised to form a solution trap to contain spillage within the cleaning area. The cover is double pan constructed and epoxy interior coated to prevent rusting. All heated tanks are fully insulated, including the cover, with a minimum 1½" fiberglass.

A sludge trap with removable sludge pan is built into the bottom of each machine. The pan can be removed for cleaning without having to drain the tank.

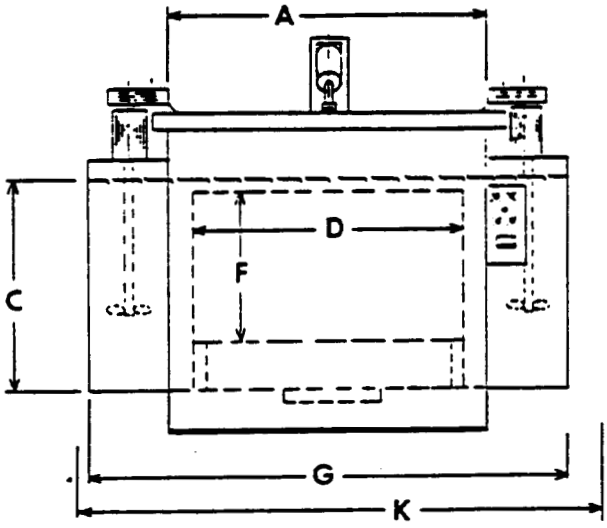
POWER OPERATED COVERS

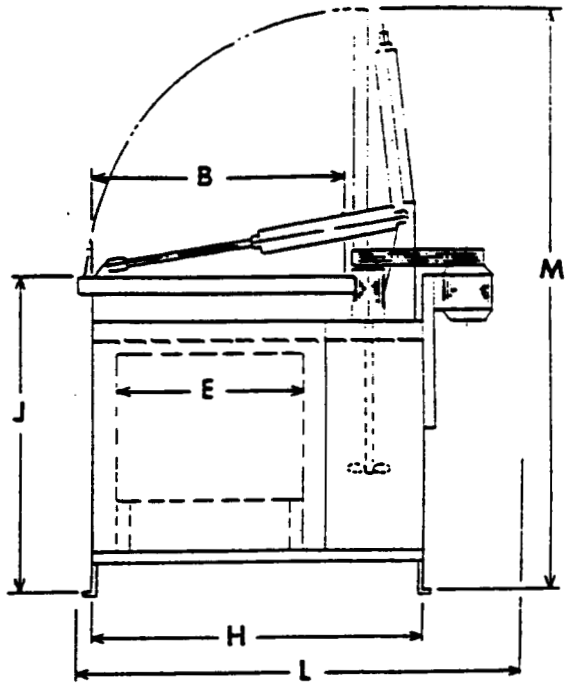
Each Vector comes standard with a heavy duty pneumatically powered cover. An air filter, regulator, lubricator is incorporated. The cover is designed to swing 90 degrees. This allows easy transfer using an overhead crane. An interlock with the Whirljet Agitation System prevents operation if the cover is left in the open position.

OTHER STANDARD FEATURES

Vector heated systems come with an indicating temperature controller, a solution low level cut-off, and a 7 day program timer. Every electrical panel uses a 110 volt control circuit for safety. Included are indicating pilot lights, heater on/off controls, stand power controls, and split load wiring for energy savings. All electric heaters are stainless steel. Larger electrically heated models incorporate top entry heaters that can be removed for periodic maintenance without having to drain the tank.

SPECIFICATIONS





VECTOR MODEL	WORK SPACE			BASKET DIMENSIONS			TANK DIMENSIONS			OVERALL DIMENSIONS			TANK CAPACITY		HEATING				MOTORS				SHIPPING	
	A	B	C	D	E	F	G	H	J	K	L	M	Level	Gal.	STM. 1	GAS 2	ELEC. 3	AMPS 460	H.P. 4	AMPS 460	H.P. 5	AMPS 460	lbs.	cu. ft.
V321	48	34	30	36	24	18	76	48	51	88	62	87	30	450	125	160	36	45	6	10	10	15	1675	250
V432	60	46	42	48	36	30	88	60	63	100	74	111	42	900	225	220	48	60	10	15	15	22	2350	385
V633	84	48	48	72	42	36	120	72	70	132	90	128	48	1475	375	500	81	101	15	22	20	28	3475	560
V844	108	60	60	96	48	48	144	78	82	156	96	142	60	2450	625	500	108	135	20	28	30	42	4400	875

NOTES

1. steam pounds per hour at 20 p.s.i.
2. gas cubic feet per hour
3. electric kilowatts
4. regular turbulance
5. heavy duty turbulance
6. 80 p.s.i. air pressure required for power cover
7. other sizes available on request

VECTOR OPTIONAL EQUIPMENT

1. filtration, cartridge type
2. filtration, cyclonic
3. oil skimmer overflow
4. automatic oil removal system
5. lip vent exhaust system
6. stainless steel construction
7. automatic transport elevator
8. programmed agitation cycle

RAMCO'S
COMPLETE APPROACH
TO INDUSTRIAL CLEANING

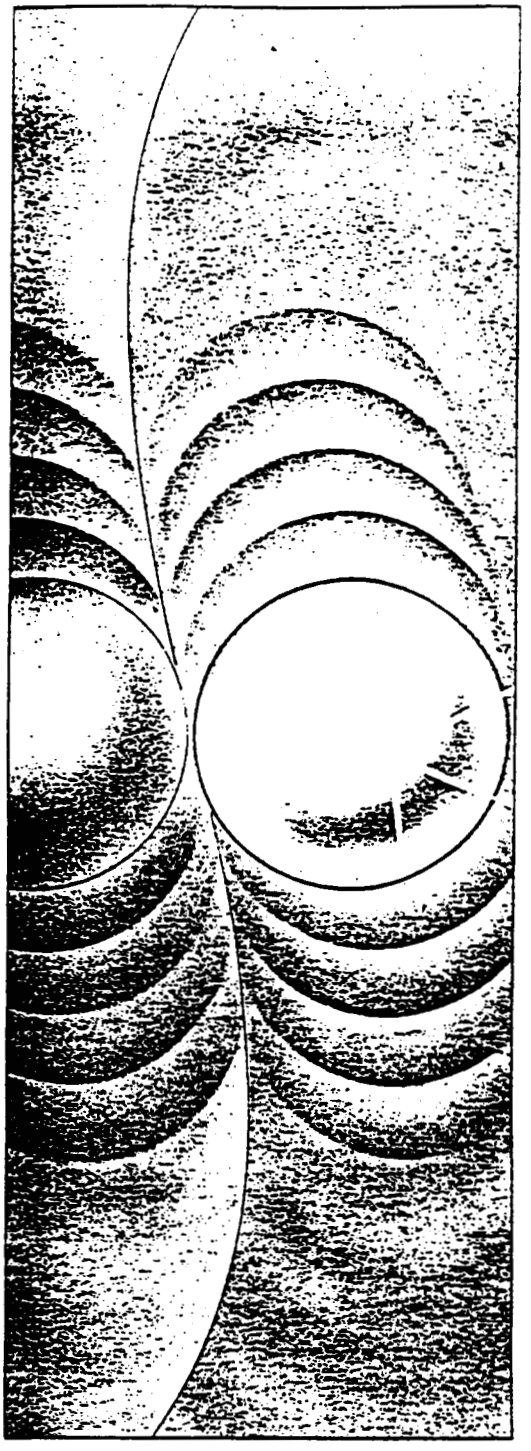
Ramco has manufactured industrial cleaning equipment for over 55 years. Continued research and service in the field has developed Ramco's "**complete approach**" to industrial cleaning. We have broadened our product line to keep pace with changing technologies and requirements. No single machine can do every job and in many cases more than one type of machine is required in order to achieve the proper result.

At Ramco we develop integrated systems. There are no shortcuts to the skill and experience required to properly design such a system. Consultation, testing and engineering are the key ingredients.

We start with your particular problem gathering complete information. Then we test various equipment and combinations of equipment each with distinct cleaning characteristics. Our test facilities incorporate a complete line of vapor degreasers, agitating washers, turbulating washers, ultrasonic cleaners, spray washers and high pressure water blast machines. Our engineers are trained to evaluate all aspects of a cleaning problem without bias toward any particular cleaning method. The result is an integrated system using standard components customized to your particular needs.

Today Ramco's experience is devoted to developing safe, dependable systems that parallel your cleaning requirements and shop environment. Man hours can be markedly reduced using simple and effective equipment. Productivity can be increased using integrated systems. Environmental pollution can be controlled with automated, efficient machines. In many cases toxic chemicals can be replaced using improved cleaning procedures.

Look to Ramco for solutions to your cleaning problems.

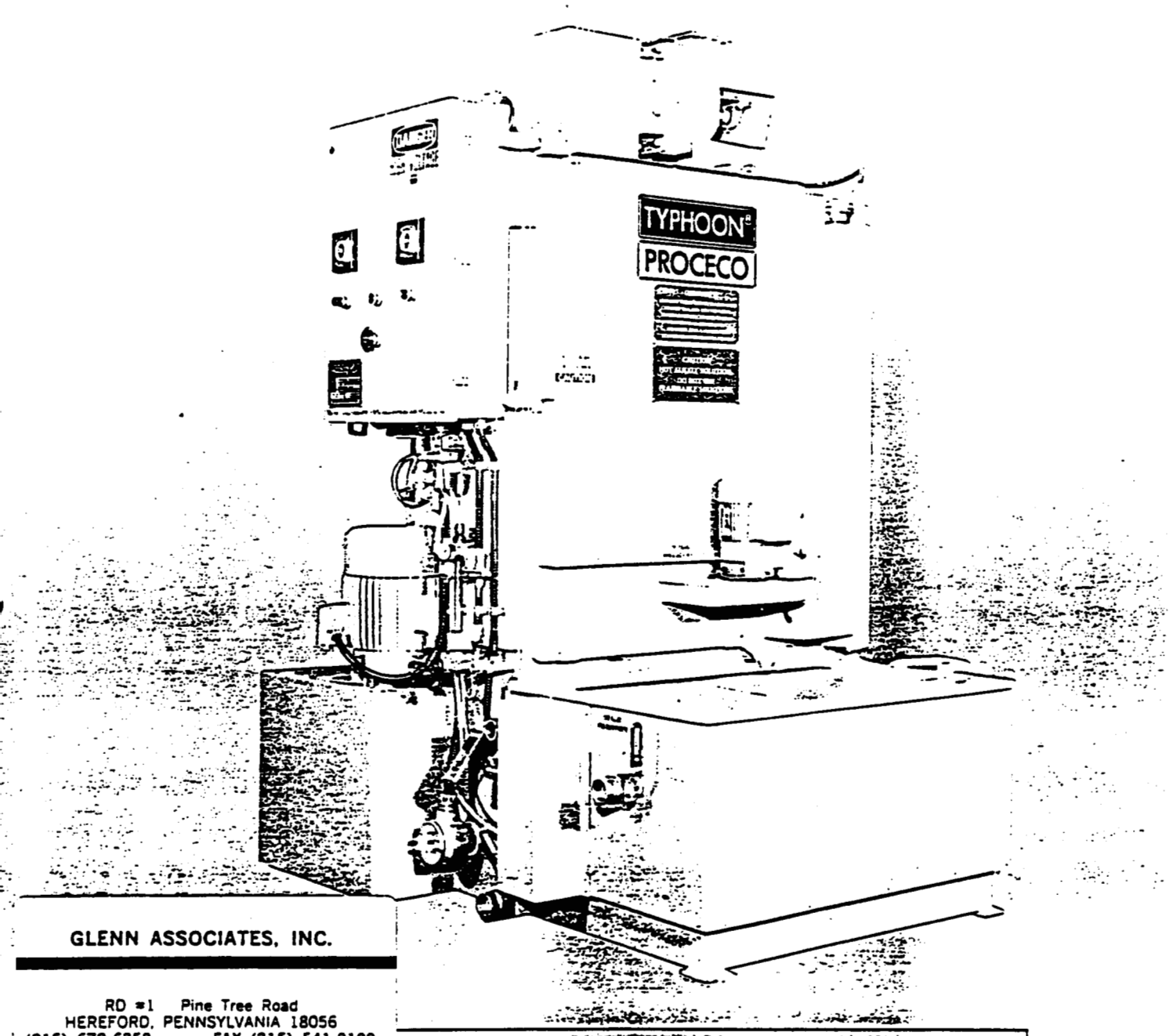


RAMCO

32 MONTGOMERY STREET, HILLSIDE, NEW JERSEY 07205
TEL 201-687-6700 • TELEX 833231 RAMCO • FAX 201-687-0653

TYPHOON® - MINI

TURNTABLE SPRAY CLEANING MACHINE



GLENN ASSOCIATES, INC.

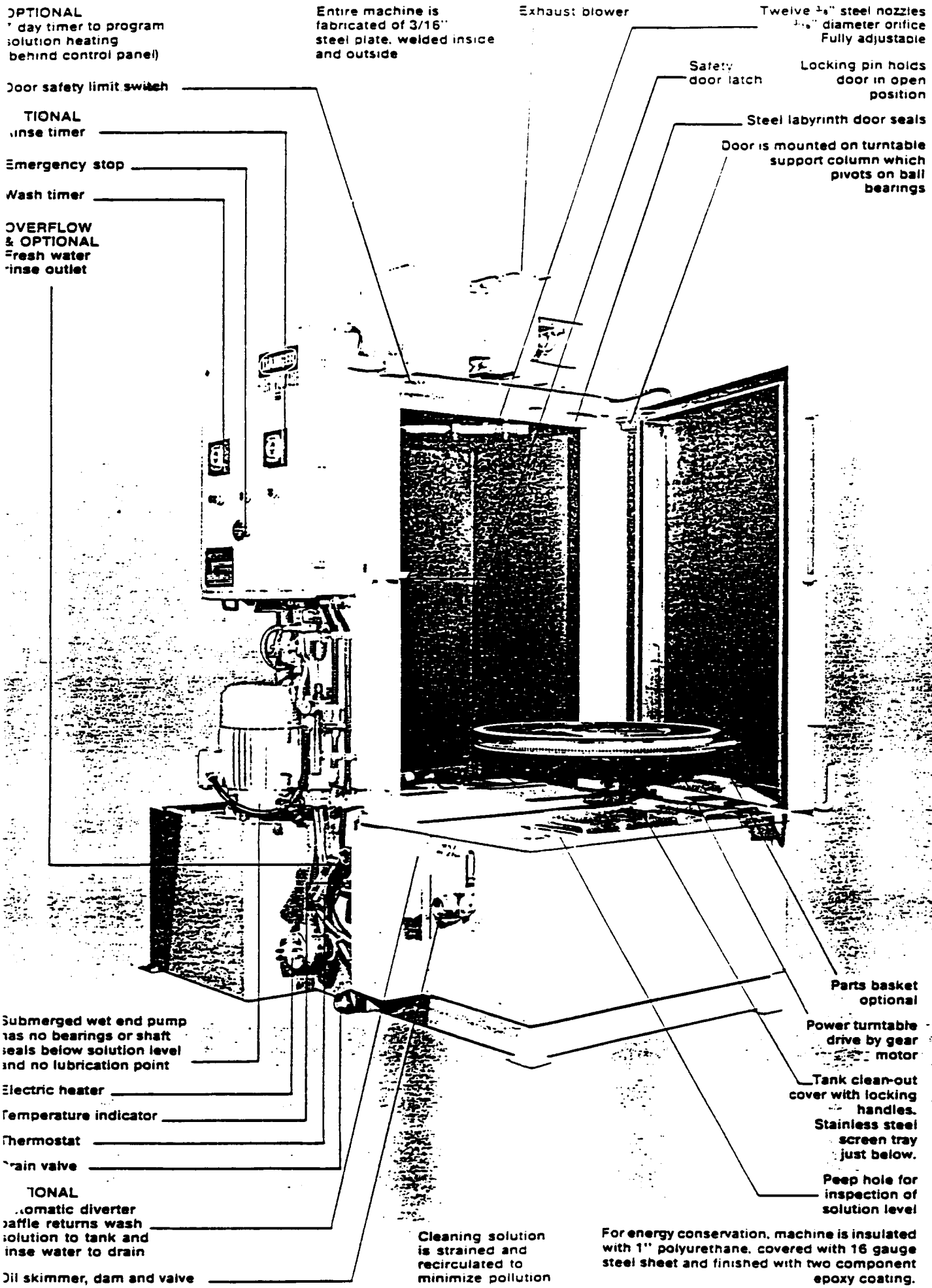
RD #1 Pine Tree Road
HEREFORD, PENNSYLVANIA 18056
(215) 679-6250 FAX (215) 541-0109

- HIGH PERFORMANCE, ECONOMY, SAFETY & CONVENIENCE.
- USES WATER-BASED, RECIRCULATED CLEANING SOLUTION.
- REPLACES SOLVENT CLEANING, VAPOUR DEGREASING, SOAK TANK & AGITATED TANK CLEANING, STEAM CLEANING & HAND CLEANING.

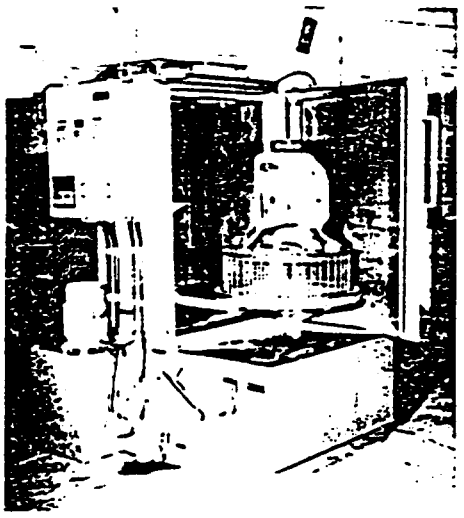
MANUFACTURING PLANTS:

PROCECO INDUSTRIAL MACHINERY LTD.
1243 DORION ST., MONTREAL, QUE., CANADA H2K 4A2 -
TELEX: 055-62262
TEL.: (514) 527-1333
FAX: (514) 527-5404

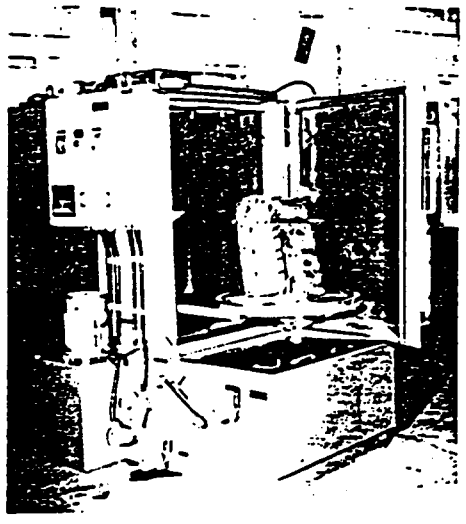
PROCECO INC.
1020 EAST 8th ST., JACKSONVILLE, FLORIDA, USA 32206 -
TEL.: (904) 355-2888
FAX: (904) 359-0910


OPTIONAL
' day timer to program
solution heating
behind control panel)
Entire machine is
fabricated of 3/16"
steel plate, welded inside
and outside
Exhaust blower
Twelve ⅛" steel nozzles
⅛" diameter orifice
Fully adjustable
Safety
door latch
Locking pin holds
door in open
position
Door safety limit switch
TIONAL
inse timer
Steel labyrinth door seals
Door is mounted on turntable
support column which
pivots on ball
bearings
Emergency stop
Wash timer
OVERFLOW
& OPTIONAL
Fresh water
inse outlet
Parts basket
optional
Power turntable
drive by gear
motor
Tank clean-out
cover with locking
handles.
Stainless steel
screen tray
just below.
Peep hole for
inspection of
solution level
Submerged wet end pump
as no bearings or shaft
eals below solution level
and no lubrication point
Electric heater
Temperature indicator
Thermostat
rain valve
TIONAL
omatic diverter
baffle returns wash
olution to tank and
inse water to drain
Oil skimmer, dam and valve
Cleaning solution
is strained and
recirculated to
minimize pollution
For energy conservation, machine is insulated
with 1" polyurethane, covered with 16 gauge
steel sheet and finished with two component
epoxy coating.

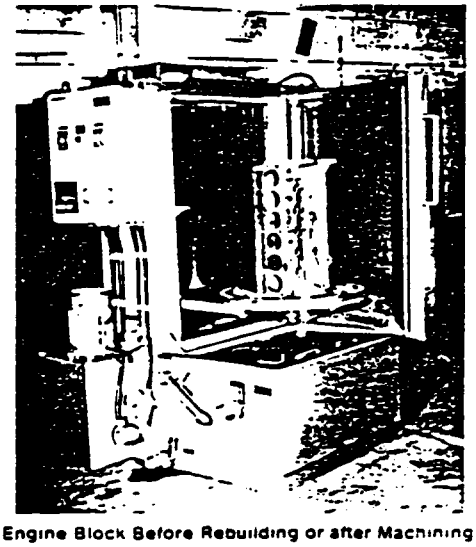
Typical Automotive Cleaning Operations:



Automotive Transmision Prior to Rebuilding



3 Unit Head Rack (Optional)
Fully Loaded with Engine Heads

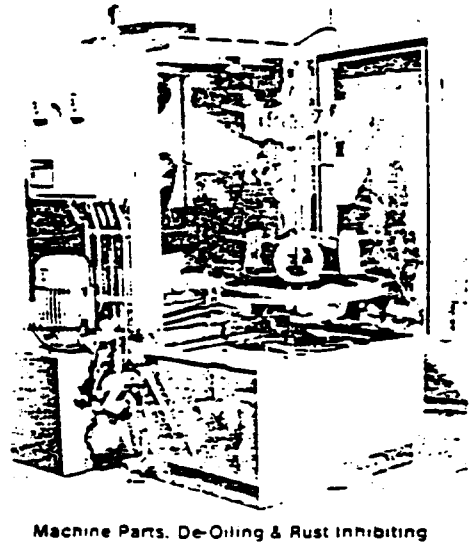


Engine Block Before Rebuilding or after Machining

A Few Industrial Cleaning Applications:

Aluminum Die Castings. Pre-Paint Conditioning

Forged Parts. Removal of Lapping Compound



Machine Parts. De-Oiling & Rust Inhibiting

TYPHOON® - MINI - MODEL SELECTION

CHOOSE ANY COMBINATION TO SUIT YOUR REQUIREMENTS.

SAMPLE MODEL NUMBER

MINI 26 — 36 — G — 1000 — C — 2 — RD

TURNTABLE DIAMETER IN INCHES*	MAXIMUM WORK HEIGHT IN INCHES*	MODE OF HEATING	TURNTABLE CAPACITY LBS	CENTER NOZZLE PIPE	RECIRCULATING STAGES	FRESH WATER RINSE
26	36	E = ELECTRIC	1000	C = YES	1 ONE	R = RINSE WATER DRAINING INTO TANK
	48	G = GAS				RD = RINSE WATER DIVERTED INTO SEWER
40	60	S = STEAM SPECIFY PRESSURE	2000	— = NO	2 TWO	VOID = NO RINSE
	72					

SPECIFICATIONS

Model	26-36	40-36
Turnable diameter ..... Inches	26	40
Maximum work height ..... Inches	36	36
Maximum load ..... Lbs.	1000	1000
Maximum load (optional) ..... Lbs.	—	2000
Solution tank capacity ..... US Gal.	130	350
With recirculating rinse (optional):		
Solution tank	125	325
Rinse tank	90	190
Pump capacity ..... US GPM/60 PSI	115	175
Pump motor wash	7½ HP	10 HP
Pump motor rinse (optional)	7½ HP	7½ HP
Exhaust blower motor	.5 HP	.5 HP
Turntable drive motor	.5 HP	.5 HP

Model	26-36	40-36
Electric heater ..... KW	12	24
or Gas (Nat. Gas or Propane)...BTU H	180,000	180,000
Depth overall	63"	78"
Width overall	55"	82"
Height overall ..... (36" high)	80"	89"
Weight ..... (36" high) Lbs.	2300	4500
Loading height above floor	32"	42"
POWER REQUIREMENTS: SPECIFY		
230 V or 460 V or 575 V 3 phase/60 cy		
For Electrically Heated Machine . KW	21	36
For Gas Heated Machine ..... KW	9	12

*LARGER MODELS AVAILABLE ON REQUEST

**POWER SUPPLY 575 V/460/230/3 PHASE/60 HZ
380 V/3 PHASE/50 HZ

OPTIONAL ACCESSORIES

1) AUTOMATIC SOLUTION LEVEL CONTROL CONSISTING OF SS FLOAT, FLOAT SWITCH AND SOLENOID VALVE
2) PRESSURE/FLOW CONTROL VALVE PLUS GAUGE
3) FORCED DRAFT EXHAUST FAN WITH CYCLE TIMER
4) SLUDGE BAFFLE
5) JIC WIRING
6) MEDIUM DUTY PARTS BASKET 26" DIA. x 8" HIGH WITH INNER BASKET AND LID
7) MEDIUM DUTY PARTS BASKET 40" DIA. x 8" HIGH WITH INNER BASKET AND LID
8) SMALL PARTS BASKET WITH LID 4" x 8" x 10"
9) 7-DAY TIMER
10) STAINLESS STEEL NOZZLES INSTEAD OF MILD STEEL
11) PLANT AIR BLOW-OFF
12) SIDE ACCESS DOOR
13) CYCLE FINISHED SIGNAL LIGHT OR HORN
14) HEAD RACK FOR ENGINE HEADS
15) AUTOMATIC RINSE WATER DIVERTER
16) SECOND RECIRCULATING STAGE

WARRANTY

PROCECO warrants each machine manufactured to be free from defects in materials, parts and workmanship under normal use and service, such obligation under this warranty being limited to making good at PROCECO's factory, any part or parts thereof which shall, within one (1) year after shipping date to the original purchaser, be returned to PROCECO with transportation charges by customer and which PROCECO's examination shall disclose to its satisfaction to have been defective. The warranty is limited to 90 days on electric motors and other electrical components. Electric heaters are not guaranteed. PROCECO does not accept any responsibility for consequential damages or losses caused by malfunction of the equipment.

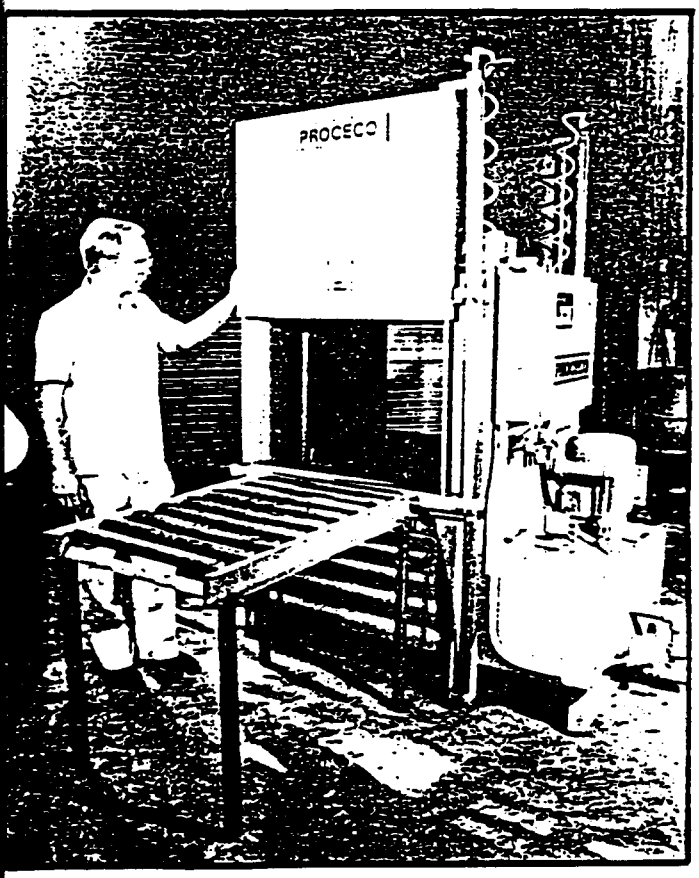
Design and specifications are subject to change without notice.

GLENN ASSOCIATES, INC.

RD #1 Pine Tree Road
HEREFORD, PENNSYLVANIA 18056
(215) 679-6250 FAX (215) 541-0109

STOP MOVING / START CLEANING

"AP" (ALL PURPOSE) Parts Washer



APPLICATIONS:

Clean & rinse
Clean & rust inhibit
Remove oil & chips
Phosphate & rinse

FLEXIBILITY:

Mild steel or stainless steel construction
Single or double guillotine doors
Flow through or shuttle
4 wheel trolleys available for parts basket
Ideal for in-conveyor integration
Large chip basket included

OTHER OPTIONS:

Utilize two in series for multi-stage process,
Eliminate central cleaning
bring cleaning to work centers,
Flexible time cycles,
Robotics can be added,

SPECIFICATIONS:

Weight capacity: 500 lbs.
Max. part size: 24" x 24" x 24"
Heated solution tank

PROCECO TYPHOON Parts Cleaner

DESIGNERS & BUILDERS OF INDUSTRIAL EQUIPMENT

MANUFACTURING PLANTS:

PROCECO INDUSTRIAL MACHINERY LTD.
1243 DORION ST., MONTREAL, QUE., CANADA H2K 4A2 -
055-62262
TEL.: (514) 527-1333
FAX: (514) 527-5404

GLENN ASSOCIATES, INC.

ECO INC.
ST 8th ST., JACKSONVILLE, FLORIDA, USA 32206 -
TEL.: (904) 355-2888
FAX: (904) 359-0910

RD #1 Pine Tree Road
HEREFORD, PENNSYLVANIA 18056
(215) 679-5250 FAX (215) 541-0109

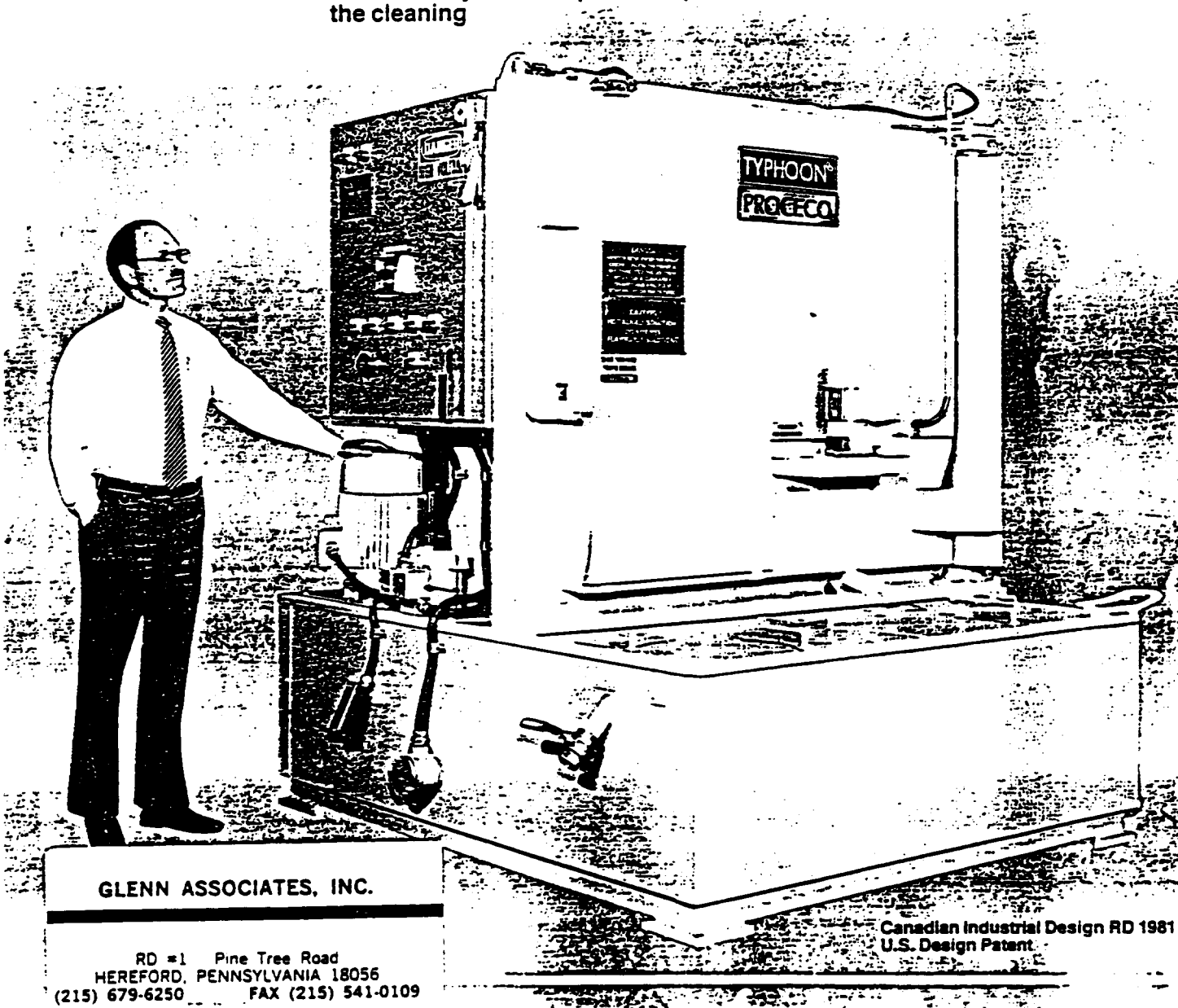
BULLETIN N°

TYPHOON®-HD

HEAVY DUTY POWER SPRAY WASHE

Why consider a spray cleaner ?

- fast cleaning due to combined chemical, heat and mechanical scrubbing ac of jets
- ideal as replacement for solvent degreasers
- recirculation principle preserves chemical, heat and water
- eliminates waste disposal problem and in house environmental difficulties
- insulation of machine keeps heat losses at a minimum
- automatic cycle timer permits operator to do other work while machine does the cleaning



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HEREFORD, PENNSYLVANIA 18056
(215) 679-6250 FAX (215) 541-0109

Canadian Industrial Design RD 1981
U.S. Design Patent

MANUFACTURING PLANTS:

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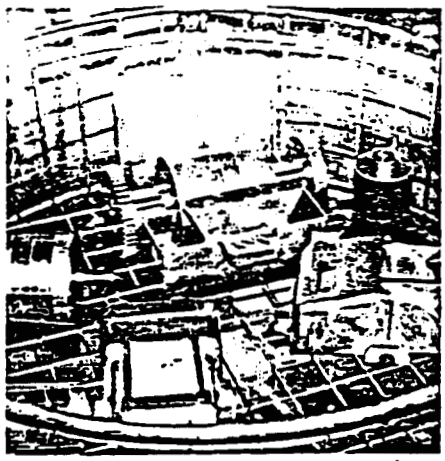
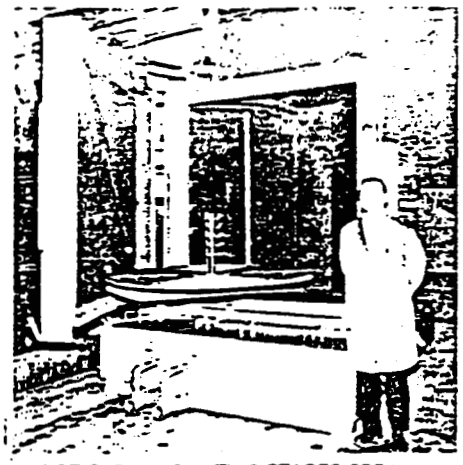
1243 DORION ST., MONTRÉAL, QUÉ., CANADA H2K 4A2 – (514) 527-1335
TÉLEX: 055-62262 FAX: (514) 527-5404

PROCECO INC.
1020 EAST 8th ST., JACKSONVILLE, FLORIDA, USA 32206 – (904) 355-2888

DUTY DEGREASING

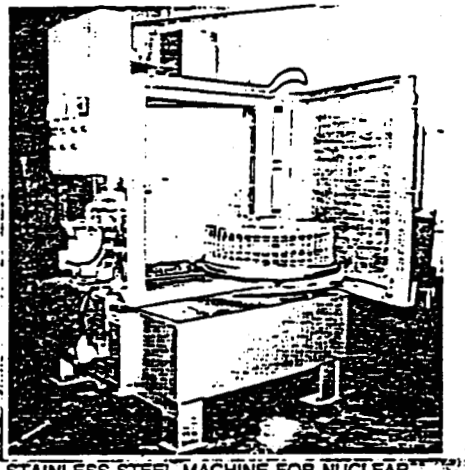


GLUE POT CLEANING AND RINSING

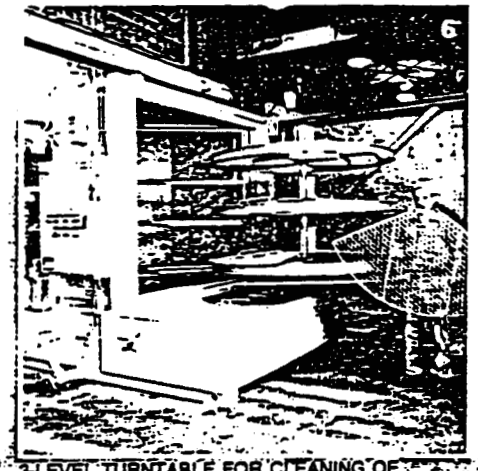


INKPOT CLEANING WITH 2 STAGES SPRAY THROUGH TURNTABLE CENTER

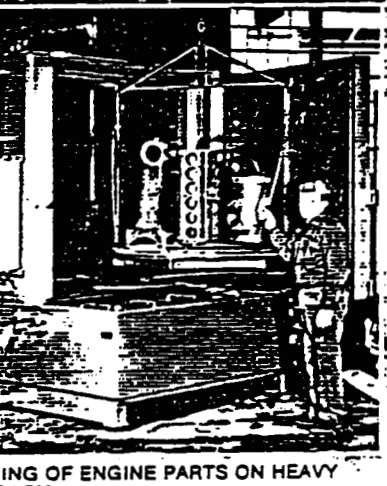
ING OF STEEL AND ALUMINUM
OWERS



STAINLESS STEEL MACHINE FOR NUCLEAR DECONTAMINATION OF TOOLS

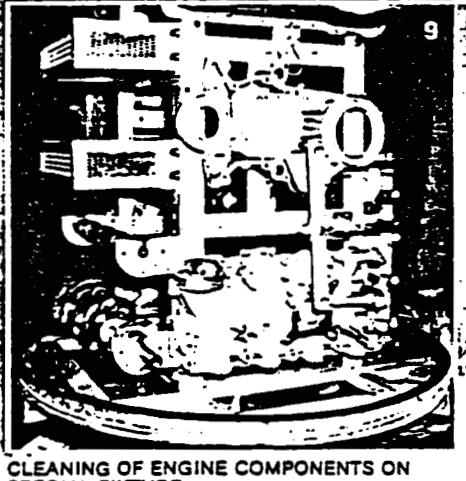


3-LEVEL TURNTABLE FOR CLEANING OF IMPREGNATION MOULD BOXES

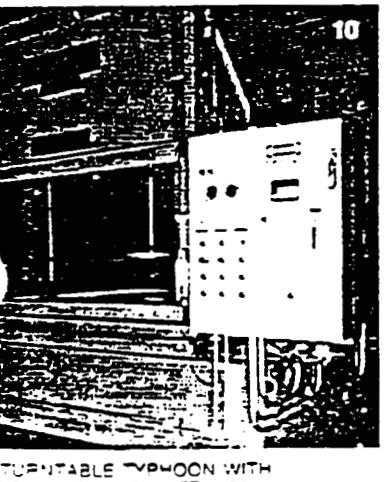


ING OF ENGINE PARTS ON HEAVY
RACK

TYPHOON EXPRESS FOR CONVEYORIZED PARTS FLOW. REQUEST BULLETIN 25

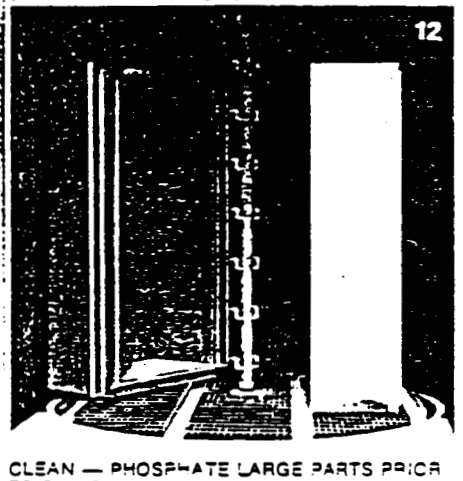


CLEANING OF ENGINE COMPONENTS ON SPECIAL FIXTURE

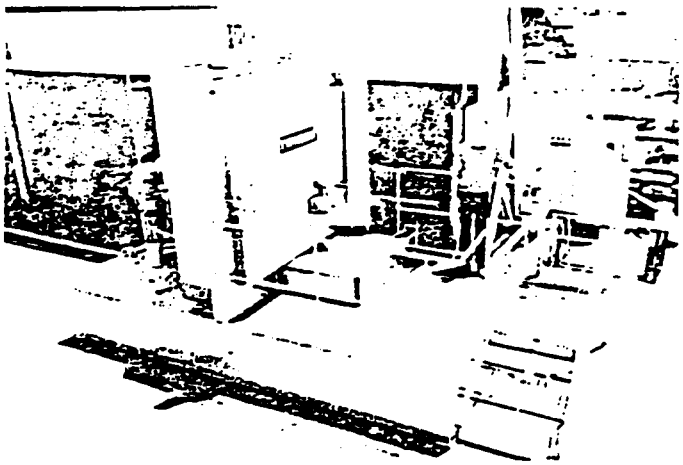


TURNTABLE TYPHOON WITH

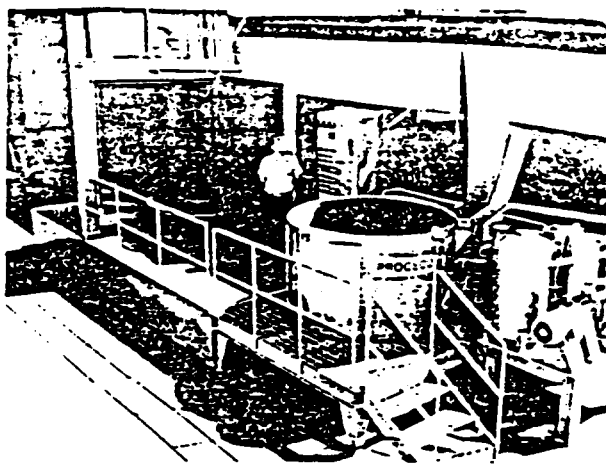
LARGE FIXED TURNTABLE WASHER —



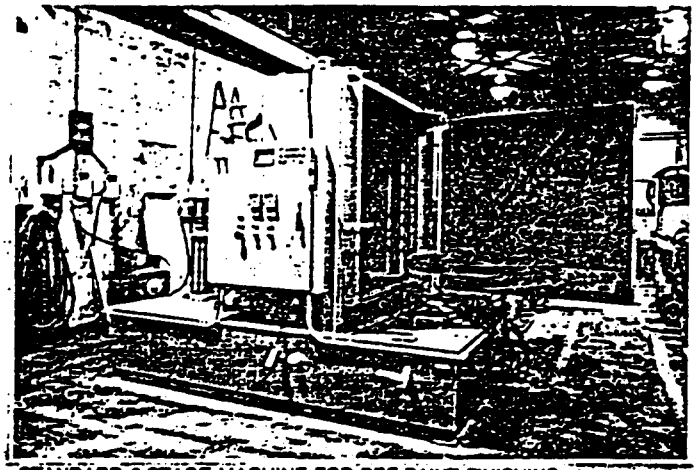
CLEAN — PHOSPHATE LARGE PARTS PRIOR



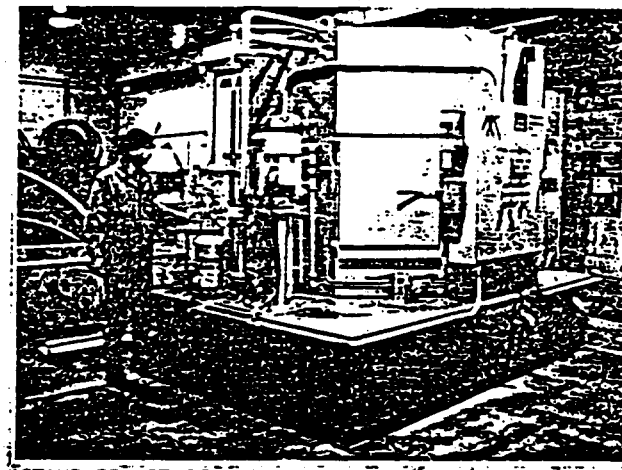
SPECIAL 2-STAGE MACHINE WITH EXTRA LARGE TANK CAPACITY.



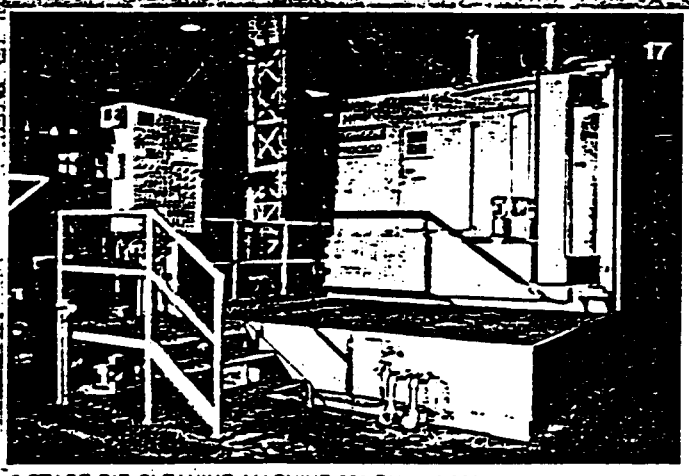
SPECIAL 2-STAGE MACHINE WITH VACUUM DRYER FOR ELECTRIC MOTORS/GENERATORS.



STANDARD 2-STAGE MACHINE FOR PRE-PAINT FINISHING. FRONT VIEW

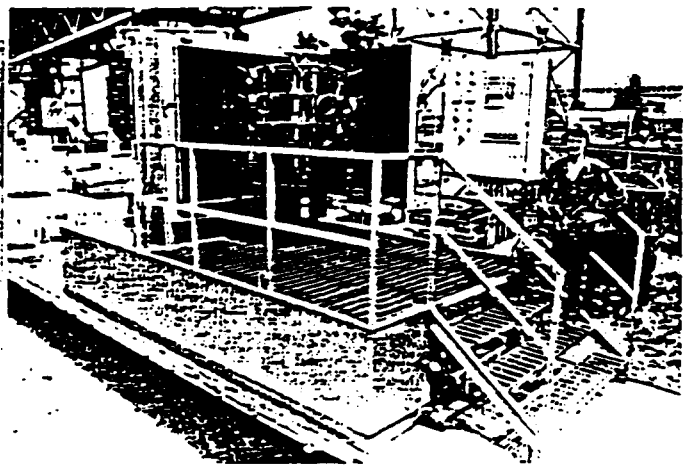


STANDARD 2-STAGE MACHINE REARVIEW. SIDE ACCESS DOOR

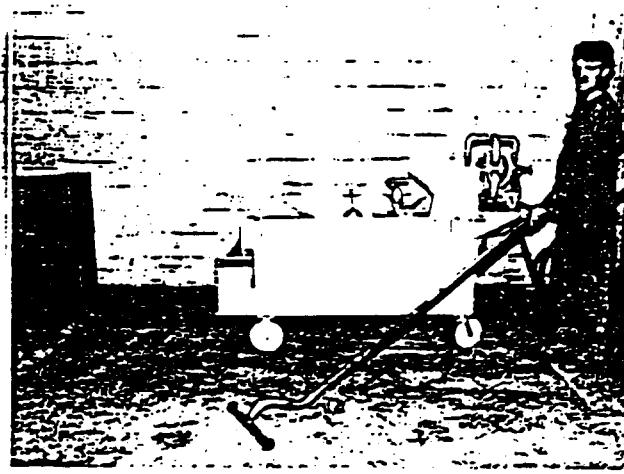


2-STAGE DIE CLEANING MACHINE 96" DIA., 10,000 lbs. TURNTABLE, POWER DOOR

2-STAGE DIE CLEANING SYSTEM 84" DIA., 5000 lbs. TURNTABLE (FORKLIFT LOADING)



2-STAGE BEARING WASHER. LARGE TANKS. WALK ON PLATFORM



MODEL DB-48 PORTABLE DESLUDGING UNIT FOR SLUDGE REMOVAL FROM TANKS

Compare outstandin

TYPICAL INDUSTRIAL APPLICATIONS INCLUDE:

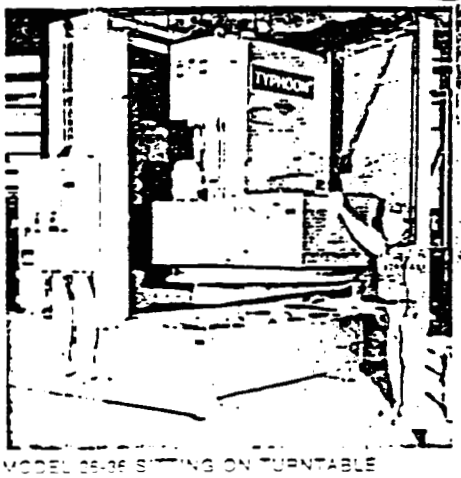
1) REMOVING MACHINING CHIPS
2) DEOILING AND DEGREASING
3) PAINT STRIPPING
4) RUST PROOFING
5) RINSING
6) PHOSPHATING PRIOR TO PAINTING

TYPICAL RAILWAY APPLICATIONS INCLUDE:

1) CLEANING OF ROOTS BLOWERS
2) CLEANING OF POWER ASSEMBLY PARTS SUCH AS CYLINDER HEADS, CYLINDER LINERS, PISTONS, CONNECTING RODS
3) CLEANING OF LOCOMOTIVE TRACTION MOTOR ARMATURES AND FRAMES
4) CLEANING OF WATERPUMPS, BEARINGS, BEARING HOUSINGS, ETC.
5) CLEANING OF ELECTRIC MOTORS
6) CLEANING OF AIR BRAKE VALVES AND COMPONENTS, ETC.

TYPICAL AUTOMOTIVE APPLICATIONS INCLUDE:

1) CLEANING OF AUTOMOTIVE ENGINE BLOCKS, HEADS AND COMPONENTS
2) CLEANING OF TRANSMISSIONS
3) CLEANING OF DIESEL ENGINE BLOCKS, HEADS AND COMPONENTS
4) CLEANING OF AXLES, DIFFERENTIALS, DRIVE TRAINS, WHEELS
5) CLEANING OF GENERATORS, ALTERNATORS, GOVERNORS, STARTERS, WATER PUMPS, BRAKES, CLUTCHES, ETC.



MODEL 36-36 SITTING ON TURNTABLE

- Tank and Cabinet fabricated of 3/16" or 1/4" steel plate. All welded construction
- One inch Polyurethane insulation plus steel outer shell, two component epoxy finish

Safety Switch
Shuts off pump when door is open

Fused Disconnect Switch
Only one power connection required

Cycle Timers for wash, rinse and exhaust

Push Button — Pilot Light
System On and Off

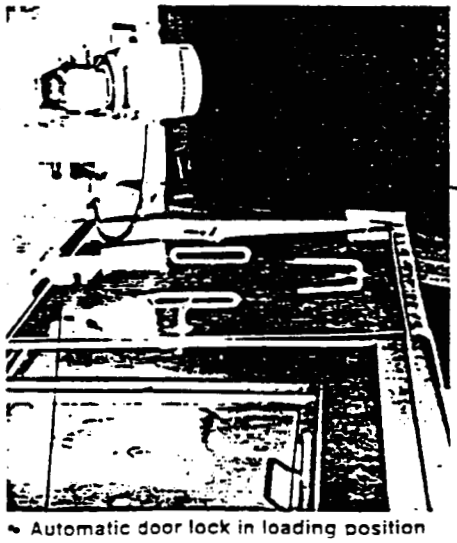
Turntable Power Jog with door in open position for easy loading and unloading

Safety Doorlatch

Temperture Indicator

Thermostat for automatic temperature control

Oil Skim
Overflow Valve



Electric Heating with stainless steel immersion element

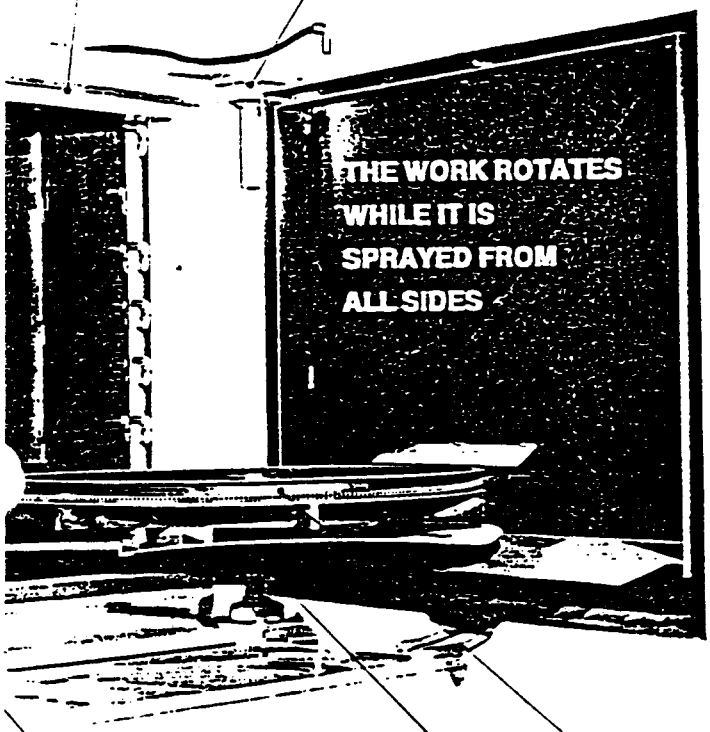
Turntable Drive

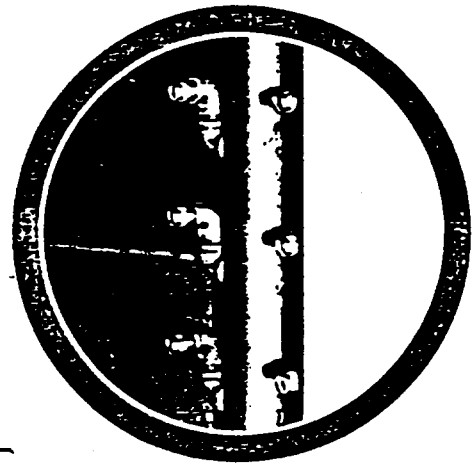
• Automatic door lock in loading position

tures built into every TYPHOON®-HD machine

)oor Seal is Steel Labyrinth
no gaskets to wear)

- Door and Turntable both mounted on ball bearings swing out together





Large Orifice V-Jet Nozzles
Fully adjustable twin vertical row

Typical use: to replace...

a. A VAPOR DEGREASER

b. HOT OR AGITATED SOAK TANK

c. STEAM CLEANER

Turntable
Drive with rollerchain
Chain slips when free rotation of turntable is blocked

Drip tray
keeps floor dry and safe

Removable Cover Plate serves as drain plate and clean out access

Air Inlet and Pneumatic Control for Oscillating Central Nozzle Pipe.

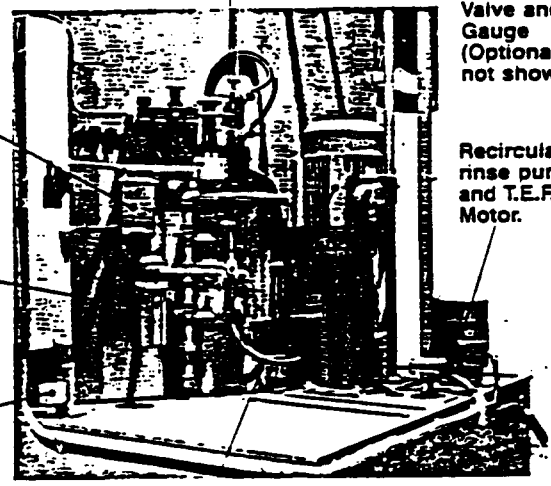
Pressure/ Flow Control Valve and Gauge (Optional, not shown)

Seven Day Programmable Timer

Recirculating rinse pump and T.E.F.C. Motor.

Fresh water inlet with Strainer and Solenoid Valve for rinse and rapid filling of tank

Automatic level control



T.E.F.C. Motor
Proceco – Submersed wet end pump.
No seal or packing.
No lubrication required.

Out of view or not shown:

in Valve
ıas Heating
Forced Air Gas Burner
Firing into immersion tube, automatic flame supervision
Steam Heating
Platecoil, with solenoid steam valve and steam trap
Sloping Floor design for rapid draining
Forced Draft Exhaust Blower

TYPHOON®-HD MODEL SELECTION

CHOOSE ANY COMBINATION TO SUIT YOUR REQUIREMENTS

Sample model number

HD 72 — 48 — E — 2000 — CO — 2 — RD

TURNTABLE DIAMETER IN INCHES*	MAX. WORK HEIGHT IN INCHES*	MODE OF HEATING	TURNTABLE CAP. LBS*	CENTER NOZZLE PIPE	NUMBER OF RECIRCULATING STAGES	FRESH WATER RINSE
48	48	E = ELECTRIC**	1000	CO = OSCILLATING	1	R = RINSE WATER DRAINING INTO TANK
60	60		2000			
72	72	G = GAS		CT = THROUGH TURNTABLE CENTER	2	RD = RINSE WATER DIVERTED INTO SEWER
84	84		5000			
96	96	S = STEAM SPECIFY STEAM PRESSURE	10,000	VOID = NO		VOID = NO RINSE
108	108					
120	120		20,000			

*LARGER MODELS AVAILABLE ON REQUEST

**POWER SUPPLY: 575V/460V/230V/3PH/60HZ
380V/3PH/50HZ

OPTIONAL ACCESSORIES

1) AUTOMATIC SOLUTION LEVEL CONTROL CONSISTING OF SS FLOAT, FLOAT SWITCH AND SOLENOID VALVE
2) PRESSURE/FLOW CONTROL VALVE PLUS GAUGE
3) FORCED DRAFT EXHAUST FAN WITH CYCLE TIMER
4) SLUDGE BAFFLE
5) JIC WIRING
6) INJECTOR FOR RUST INHIBITOR
7) MEDIUM DUTY PARTS BASKET 48" DIA. X 8" HIGH WITH INNER BASKET AND LID
8) HEAVY DUTY LOAD TRAY WITH LOAD BAR 48" DIA. — 1800 LB CAPACITY
9) SMALL PARTS BASKET WITH LID 4" X 8" X 10"
10) LOADING BOOM 1000 LB CAPACITY, 8FT. SWING OVER 220°
11) MIRROR IMAGE
12) STAINLESS STEEL CONSTRUCTION
13) 7-DAY TIMER
14) STAINLESS STEEL NOZZLES INSTEAD OF MILD STEEL
15) PLANT AIR BLOW-OFF
16) SIDE ACCESS DOOR
17) CYCLE FINISHED SIGNAL LIGHT OR HORN
18) FULL FLOW FILTRATION SYSTEM
19) INCREASED PUMP PRESSURE FOR EXTRA CLEANING POWER

WARRANTY

PROCECO warrants each machine manufactured to be free from defects in matenals, parts, and workmanship under normal use and service, such obligation under this warranty being limited to making good at PROCECO's factory, any part or parts thereof which shall, within one (1) year after shipping date to the original purchaser, be returned to PROCECO with transportation charges by customer and which PROCECO's examination shall disclose to its satisfaction to have been defective. The warranty is limited to 90 days on electric motors and other electrical components. Electric heaters and not guaranteed. PROCECO does not accept any responsibility for consequential damages or losses caused by malfunction of the equipment.

GLENN ASSOCIATES, INC.

RD #1 Pine Tree Road
HEREFORD PENNSYLVANIA 18056
PHONE (215) 679-5352 FAX (215) 541-0109

Spray Washing Cabinets...

Clean parts automatically with soap and water

MFG. BY BETTER ENGINEERING

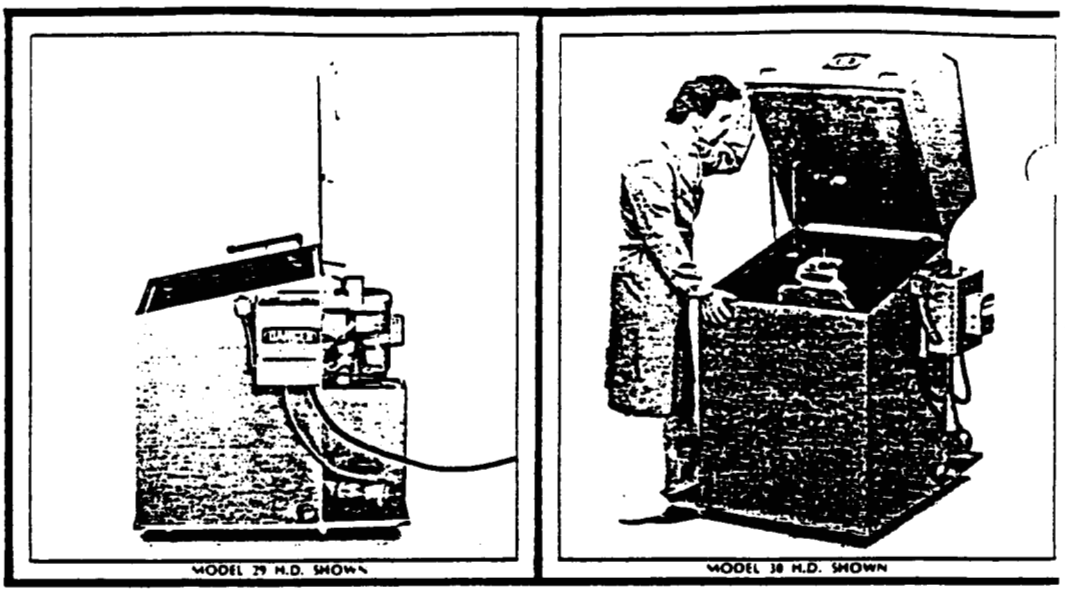
The Industrial & Automotive Cleaning Specialist

arts are eaned in Easy Steps

Operator loads parts, sets the wash cycle timer, and returns to income producing task.

As the turntable rotates at 3 RPMs, the parts are blasted from all angles with a hot (160°F - 200°F) soap and water solution at a rate of 30-60 GPMs. (Spray nozzles are located above, below and on one or more sides of the turntable). After the solution hits the parts, it is filtered and recycled. The force of the spray jets, the heat, and the detergent combine to strip oil, grease, carbon, etc. . . . in 1-15 minutes.

The operator unloads the clean parts, which flash dry in seconds.



MODEL 29 H.D. SHOWN

MODEL 30 H.D. SHOWN

The Model 29 and the more powerful 29 H.D. are compact, portable spray washers that require no plumbing connections. The Model 29 has a 4.5 kw heating element and a 1.5 H.P. pump/motor; this unit is restricted to aluminum safe detergents. The 29 H.D., with a 6 kw heating element and a 2 H.P., vertical pump/motor (no mechanical seal!) can handle all spray washing detergents.

The Model 30 and the more powerful 30 H.D. are exactly the same as the 29 and 29 H.D., respectively, except for the higher hood. With 32 inches of inside vertical clearance, these units are built for longer pieces such as automatic transmission cases, engine components, large castings, etc. . . .

		29	29 H.D.	30	30 H.D.
ıde working dimensions:	Height	24"	24"	32"	32"
	Turntable Diameter	27"	27"	27"	27"
erall dimensions:	Height	42"	42"	50"	50"
	Floor space	38" x 42"	38" x 42"	38" x 42"	38" x 42"
ık size		40 gal.	50 gal.	40 gal.	50 gal.
rntable weight capacity		300 lbs.	300 lbs.	300 lbs.	300 lbs.
ndard power source		220V, 1 phase	220V, 1 phase	220V, 1 phase	220V, 1 phase
l load amps		30	35	30	35
mp motor:	Type	Horizontal	Vertical	Horizontal	Vertical
	Size	1.5 H.P.	2 H.P.	1.5 H.P.	2 H.P.
	Output	30 GPM / 40 PSI	30 GPM / 60 PSI	30 GPM / 40 PSI	30 GPM / 60 PSI
at Source	Electric	4.5 kw	6 kw	4.5 kw	6 kw
restrictions on detergent		Yes, aluminum safe	No	Yes, aluminum safe	No
rtable		Yes	Yes	Yes	Yes
pping weight		500 lbs.	500 lbs.	550 lbs.	550 lbs.

RETURN ON /ESTMENT

=

Labor Savings
Only labor needed is for loading and unloading parts.

+

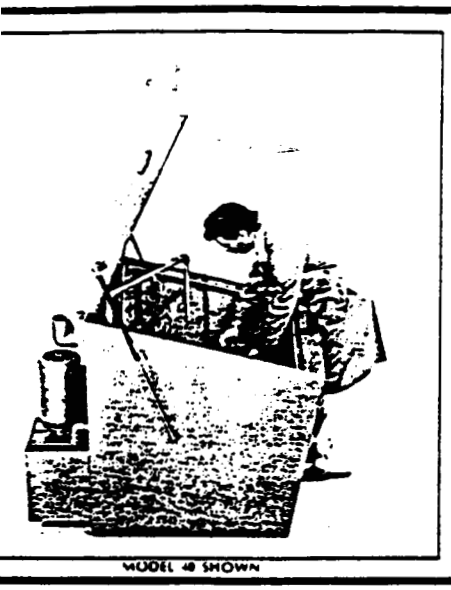
Solvent Expenditure
Water and inexpensive detergents are used instead of petrochemical solvents

+

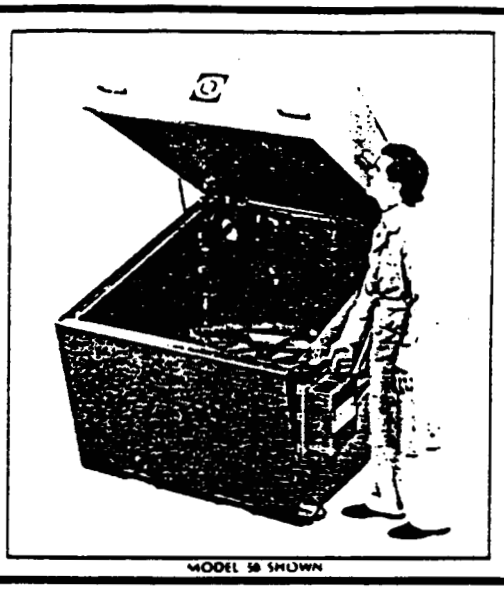
Greater Productivity
Cleaning times are reduced from hours or even days to just minutes.

+

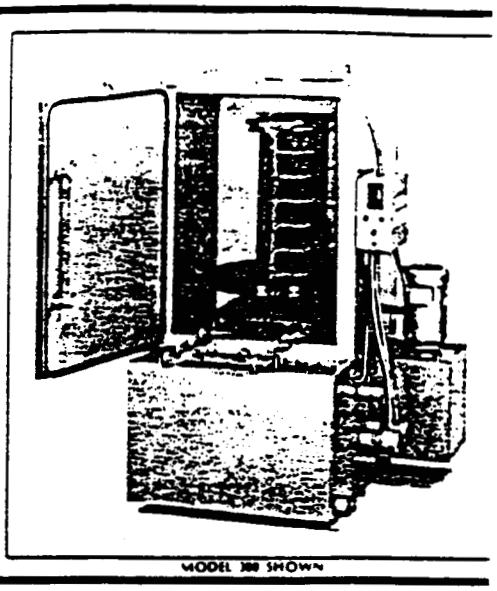
Improved Shop Environment
Detergents are odorless, non-toxic and biodegradable. Cleaning is done in closed system



MODEL 40 SHOWN



MODEL 50 SHOWN



MODEL 300 SHOWN

The Model 40 parts washer is a stationary unit which has roughly twice the turntable area as the 29 and 30 models. In most cases this means twice as many work pieces can be cleaned per wash cycle. Notice how all the top loading cabinets are sloped towards the front for convenient loading. The greatest reach required is only 16".

The Model 50 is similar in design to the Model 40. With a 48 inch diameter turntable which can handle up to 1000 lbs., the load per wash cycle is incredible. The hood on the Model 50 is pneumatically controlled with the flip of a switch. Both the Model 40 and 50 have a 5 H.P., vertical pump/motor which has no detergent restrictions.

The Model 300 is a front loading washer. The turntable glides completely clear of the doorway over a series of steel rollers. With a 28 inch turntable diameter and 36 inchs of inside vertical clearance, this washer is designed to direct maximum cleaning force on larger pieces such as engine blocks.

40	50	300
26" 37"	26" 47"	36" 32"
48" 49" x 59"	48" 59" x 69"	70" 54" x 58"
70 gal.	100 gal.	100 gal.
750 lbs.	1000 lbs.	1000 lbs.
220V, 3 phase	220V, 3 phase	220V, 3 phase
42	42	42
Vertical 5 H.P. 60 GPM / 60 PSI	Vertical 5 H.P. 60 GPM / 60 PSI	Vertical 5 H.P. 60 GPM / 60 PSI
2-6 kw	2-6 kw	2-6 kw
No	No	No
No	No	No
750	1000	1000

Applications

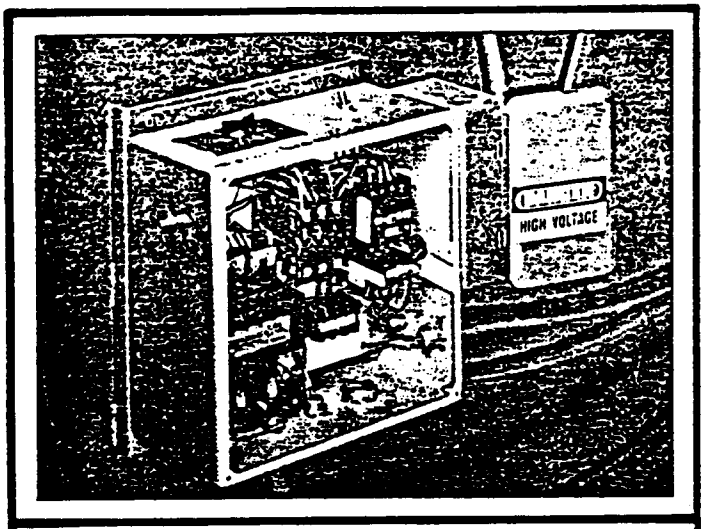
Wherever parts are cleaned on a regular basis, Better Engineering's spray washing cabinets will offer a fabulous return on investment. Manufacturing, repair, and maintenance facilities are changing from hand cleaning, soaking in petrochemicals, vapor degreasing, steam cleaning, etc. . . . to spray washing. Spray washers are ideal for steel manufacturers, machine shops, automotive repair, electric motor repair, machine maintenance, etc. . . .

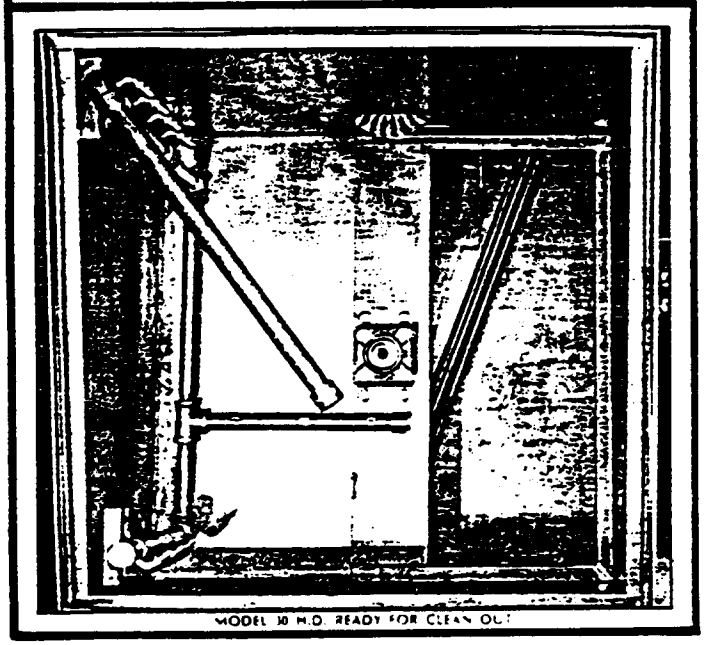
Custom Spray Washers

In addition to manufacturing seven production spray washers Better Engineering offers custom built machines. A production cabinet can be modified (e.g., increase weight capacity, parts basket design, etc.) or a completely different cabinet can be built. Invite your local Better Engineering representative to analyze your cleaning application.

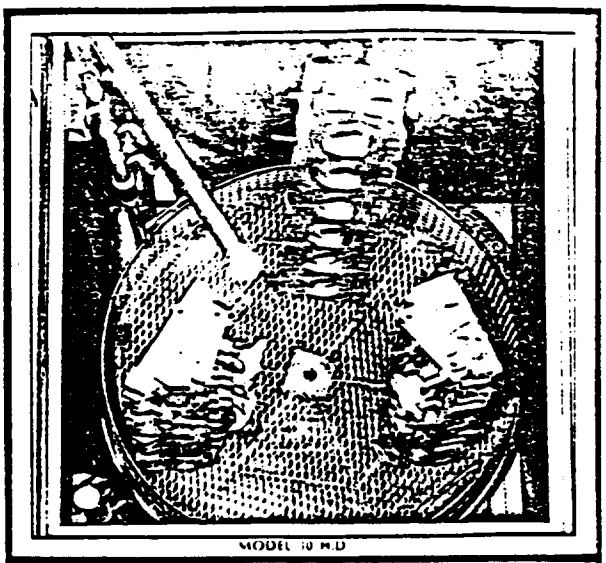
Superior Quality

- Sturdy 11 gauge steel cabinets.
- To minimize clean-out time, tank floors are pitched towards the drain, and the tank area is made accessible by having a slip-out turntable and removeable tank cover plate.
- Traction drive system allows optimum turntable speed without pitfalls of a gear driven system.
- No seals or bearings below solution level.
- Steel nozzles for exact spray pattern and most efficient pressure/volume ratio.
- Electric boxes are water sealed, control circuits are fused, all components meet NEMA standards.

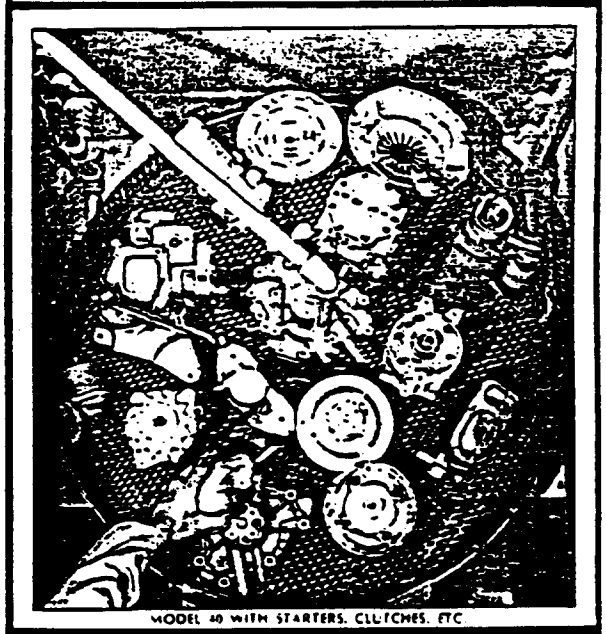




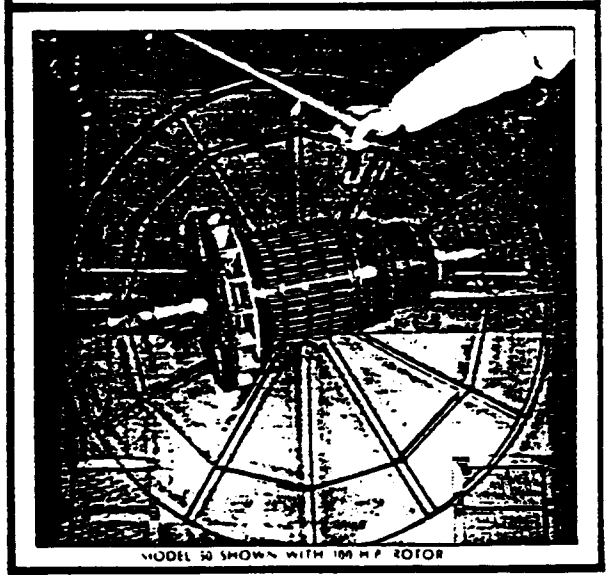
MODEL 30 M.D. READY FOR CLEAN OUT



MODEL 10 M.D



MODEL 40 WITH STARTERS, CLUTCHES, ETC.



MODEL 50 SHOWN WITH 100 H.P. ROTOR

Options

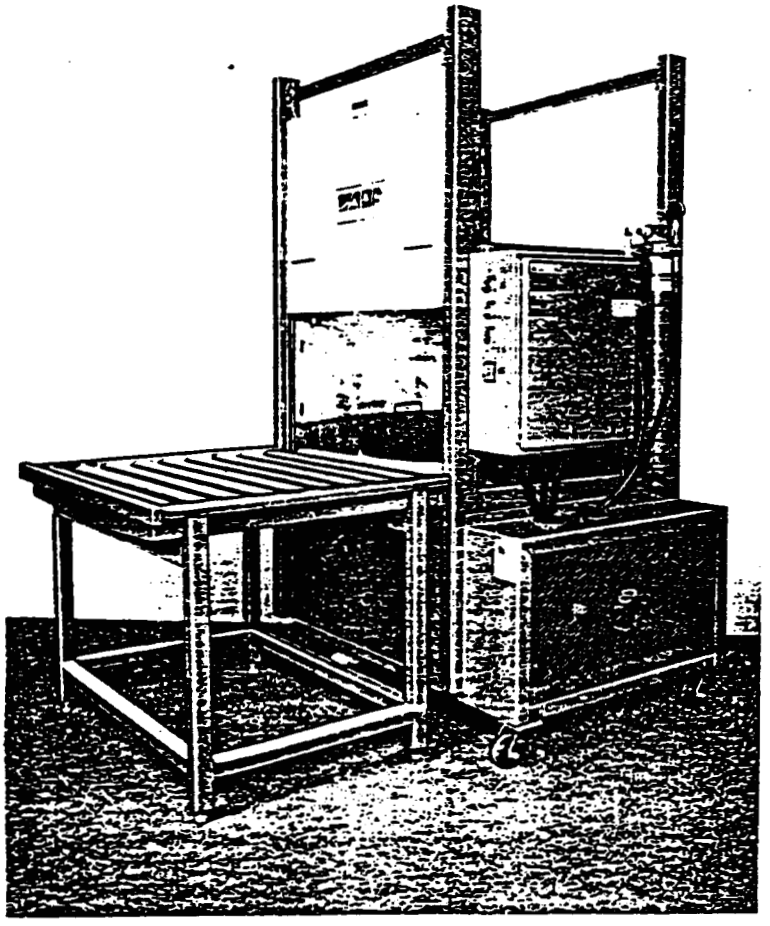
- Automatic 24-Hour, 7 day time clock for heat
- Hydro-air rinse gun
- Automatic fresh water rinse
- Low water safety shut-off
- Automatic water fill
- Single or three phase electric conversion from standard

Better Engineering
7101 Belair Road
Baltimore, MD 21206
Toll Free 1-800-638-3380
In Maryland 882-6000

ADF PARTS WASHERS

MODEL 900 SERIES

SOLVENT FREE CLEANING



Pictured With Optional Double Doors and Casters.

FEATURES

- EASY roller table loading and unloading.
- Convenient lift up door.
- Flow through operation with double door option.
- Load the washer using baskets or put larger parts directly on the rollers.
- Controls conveniently located at operator work position.

ADF SYSTEMS, LTD.
P.O. Box 278 • Humboldt, Iowa 50548 • Telephone: (515) 332-5400 • Fax: (515) 332-4475

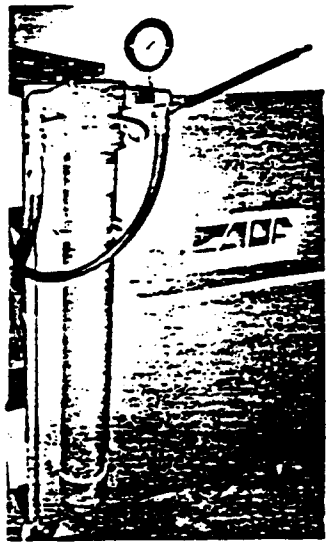
MADE IN U.S.A.

TECHNICAL INFORMATION

MODEL SERIES	920						960			
PART NUMBER	9234-024	9234-032	9234-042	9244-024	9244-032	9244-042	9634-032	9634-042	9644-032	9644-042
PUMP OUTPUT	7 GPM						18 GPM			
OPERATING PRESSURE	to 750 PSI	to 700 PSI	to 650 PSI	to 750 PSI	to 700 PSI	to 650 PSI	to 700 PSI	to 650 PSI	to 700 PSI	to 650 PSI
PUMP MOTOR	5 HP, 208/230V/60HZ 3 PH			5 HP, 460V/60HZ/3PH			10 HP, 208/230V/60HZ/3PH		10 HP, 460V/60HZ/3PH	
PUMP	3 Cylinder Axial Diaphragm Type									
CONTROLS	All 115 Volt Fused									
TIMER	Electronic Timer With Push Button Start-Stop									
HEATER	Electric Plug, Stainless Steel Plug, Incaloy Elements, 7.5 KW									
HEATER VOLTAGE	208/230V/3 PH			460V/3 PH			208/230V/3 PH		460V/3 PH	
MAXIMUM TEMPERATURE	160 Degree F.									
TEMPERATURE CONTROL	Thermostat Control in Immersion Heater Box									
FILTER	All Have Filter Tray With Felt Filter									
RESERVOIR TANK	20 Gallons	37 Gallons	56 Gallons	20 Gallons	37 Gallons	56 Gallons	37 Gallons	56 Gallons	37 Gallons	56 Gallons
CONSTRUCTION	Chassis and Tanks - 304 Stainless Steel									
STATIONARY	Standard With 4 Adjustable Legs									
BASKET	24" Dia.	32" Dia.	42" Dia.	24" Dia.	32" Dia.	42" Dia.	32" Dia.	42" Dia.	32" Dia.	42" Dia.
TURNTABLE	24"	32"	42"	24"	32"	42"	32"	42"	32"	42"
TURNTABLE ROTATION	12 RPM	6 RPM		12RPM	6 RPM					
NUMBER OF NOZZLES	8	9	10	8	9	10	18	20	18	20
MACHINE OPENING SIZE	W:24"xH:18"	W:32"xH:18"	W:42"xH:18"	W:24"xH:18"	W:32"xH:18"	W:42"xH:18"	W:32"xH:18"	W:42"xH:18"	W:32"xH:18"	W:42"xH:18"
DOOR	Standard With 1 Lift Up Door									
DIMENSIONS	LxWxH 35"x54"x93"	LxWxH 43"x54"x93"	LxWxH 53"x54"x93"	LxWxH 35"x54"x93"	LxWxH 43"x54"x93"	LxWxH 53"x54"x93"	LxWxH 43"x54"93"	LxWxH 53"x64"x93"	LxWxH 43"x54"x93"	LxWxH 53"x64"x93"
NET WEIGHT	880 lbs.	1080 lbs.	1280 lbs.	880 lbs.	1080 lbs.	1280 lbs.	940 lbs.	1140 lbs.	940 lbs.	1140 lbs.
SHIPPING WEIGHT	960 bls.	1160 lbs.	1360 lbs.	960 lbs.	1160 lbs.	1360 lbs.	1140 lbs.	1220 lbs.	1140 lbs.	1220 lbs.

AVAILABLE OPTIONS:

1. AIR BLOW OFF, COMPRESSED AIR: Using the customers air; parts are dried in the washer.
2. RINSE SYSTEM: Available on Units with 32" or 42" turntables, provides a recirculating wash cycle followed by a rinse to drain cycle.
3. CUSTOM MADE BASKETS: Baskets made to customer specifications.
4. PORTABILITY: on 4 Heavy Duty Casters.
5. HIGH PRESSURE filter option.
6. AIR DRY HEATED BLOWER: Electric heater with blower to provide hot air for drying.
7. OIL SKIMMER: Stainless Steel, Wheel Type Skimmer, for oil removal.
8. FUSED DISCONNECTS: Fused box is mounted on washer for disconnection.
9. DOUBLE DOORS: This option provides a second door for flow through operations. Included is a second roller table.
10. SEVEN DAY TIMER: For controlling on-off times of electric heaters.



The high pressure filter option for 920 Series pictured here allows filtering to 3 micron. Model 960 requires a double filter option.

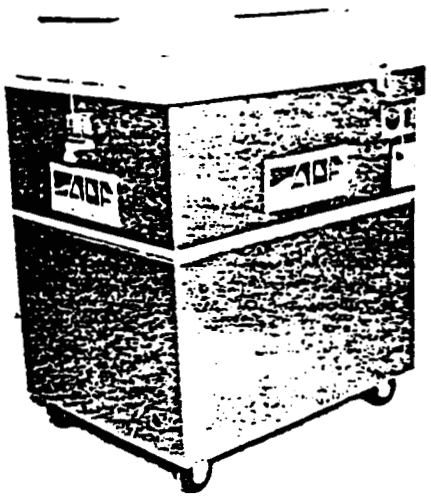
REV. 9/90

ADF SYSTEMS, LTD.

P.O. Box. 278
Humboldt, Iowa 50548

DISTRIBUTED BY

ADF SERIES 700/800/850 PARTS WASHERS



SOLVENT FREE CLEANING

ADF PARTS WASHERS feature the use of hot high pressure water and detergents for cleaning as an alternative to solvent type cleaners.

SAFETY AND HEALTH problems associated with solvent type cleaners are avoided using the ADF washers.

COSTS can be reduced using water and detergents instead of solvents. When computing cost, do not forget to include solvent disposal cost, now a major cost for solvent type cleaners. The detergent cost for the ADF washer may be as small as $.10 per gallon, depending on your cleaning operation and requirements.

CLEANING TIME also may be reduced with the ADF washer. With the combination of the high pressure, hot water, and detergents, most parts can be cleaned in 1 to 4 minute cycles. Remember, your operators can load the washer, close the lid, set the timer, and continue to work while the washer does its work.

WORK CELLS are a natural for the washer because of the size, portability, and short cycle time. No need for water connections or drains with this self-contained washer.

PORTABILITY is another feature of ADF parts washer. No need for water connections or drains as the washers are self-contained and portable. The washer can be moved from location to location for cleaning or used semi-stationary at a work station.

NOZZLE PATTERN is important for any cleaning operation. The nozzles in the ADF washers are arranged for general cleaning and will provide good cleaning coverage for most parts. However, if you have parts which have special cleaning problems such as recesses, blind holes, angle holes, etc., the nozzles are easily adjusted to provide a special pattern for your parts. Nozzle arrangement can be changed in just a few minutes, which allows the customizing of the cleaning pattern for many parts.

SAFETY FEATURES for operator and machine protection are included on ADF washers. All machines are equipped with a snap action safety switch on the lid so if it is opened during operation, the pump motor is shut off. All operator controls are 115 volt regardless of machine voltage. The reservoir tank includes a level switch so if the solution level gets too low, the machine is shut down to protect the pump and immersion heater.

ADF SYSTEMS, LTD.

ADF SYSTEMS, LTD.

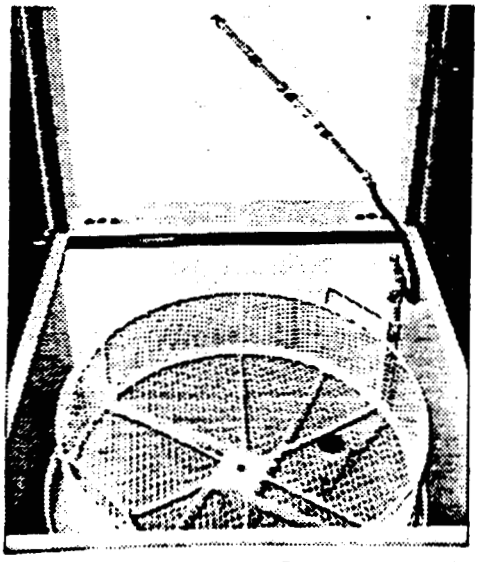
1103 16TH AVENUE NORTH — P.O. BOX 278
HUMBOLDT, IOWA 50548
TELEPHONE: 515-332-5400
FAX: 515-332-4475

MODEL SERIES	700		800		850	
PART NUMBER	7034	7044	8034	8044	8534	8544
PUMP OUTPUT	7 GPM					
OPERATING PRESSURE	to 750 PSI				650 PSI	
PUMP MOTOR	5HP, 3 PH, 208-230V	5 HP, 3 PH 460V	5 HP, 3 PH, 208-230V	5 HP, 3 PH, 460V	5 HP 3 PH, 208-230V	5 HP, 3 PH, 460V
PUMP	3 Cylinder Axial Diaphragm Type					
CONTROLS	All 115 Volt Fused					
TIMER	Spring Wound 15 Minute					
HEATER	Electric Plug, Stainless Steel Plug, Incaloy Elements, 7.5 KW					
HEATER VOLTAGE	208/230V/3/PH	460V 3PH	208/230V/3PH	460V/3PH	208 230V 3PH	460V/3PH
MAXIMUM TEMPERATURE	160 Degree F.					
TEMPERATURE CONTROL	Thermostat Control in Immersion Heater Box					
FILTER	All have filter tray with felt filter.					
RESERVOIR TANK	13 gallon removable tank		37 gallon fixed position tank		56 gallon fixed position tank	
CONSTRUCTION	Chassis and Tanks - 304 Stainless Steel					
PORTABILITY	Mounted on 4 Heavy Duty Casters					
ELECTRICAL CONNECTION	Convenient Terminal Block in Electrical Box					
BASKET	23" Diameter x 4" High		32" Diameter x 4" High		42" Diameter x 4" High	
BASKET ROTATION	12 RPM		6 RPM, Belt driven by a gear motor			
BASKET MATERIAL	Vinyl Dip-Coated over Carbon Steel					
NUMBER OF NOZZLES	9				10	
DIMENSIONS	34" Long x 29" Wide x 47" High		42" Long x 36" Wide x 48" High		52" Long x 46" Wide x 50" High	
NET WEIGHT	495 Pounds		550 Pounds		600 Pounds	
SHIPPING WEIGHT	560 Pounds		620 Pounds		680 Pounds	

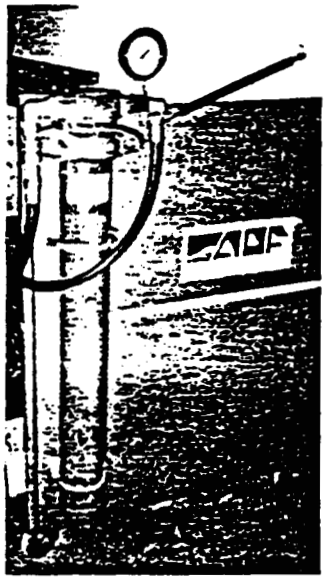
AVAILABLE OPTIONS:

1. AIR DRY: Using the customers compressed air, parts are dried in the washer.
2. 2 STAGE SYSTEM: Available only on 800 Series, provides a recirculating wash cycle followed by a rinse to drain cycle.
3. ELECTRONIC TIMER: Replaces the spring wound timer. Provides push botton start.
4. CUSTOM MADE BASKETS: Baskets made to customer specifications.
5. OIL SKIMMER

PRICES AND SPECIFICATIONS SUBJECT TO CHANGES WITHOUT NOTICE



Interior of the parts washer. Shown is the basket and nozzle arrangement. Nozzles are positioned on the bottom, side, and top of the washer for complete coverage.



The high pressure filter option pictured here allows filtering to 3 micron.

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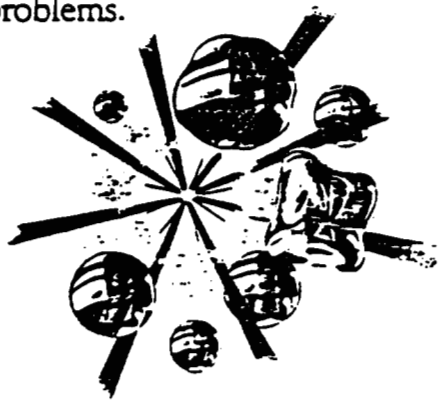
FAX 515-332 4475

Branson – The Clean Idea People

At every stage of manufacturing, dirt, grease and other contaminants can coat product surfaces and get into tiny cracks and crevices where they can cause *big* problems. As technology advances, product and component cleanliness is increasingly critical. And trends toward micro-miniaturization further compound industry cleaning challenges.

Since 1946, Branson has been a major force in advancing ultrasonic technology. We've applied the principles of ultrasonic power to a broad line of aqueous cleaners, solvent degreasers, and modular bench systems. Today Branson, The Clean Idea People, can offer you powerful, thorough and cost-efficient solutions to your toughest cleaning problems.



Ultrasonic cleaning action is powered by millions of microscopic implosions. Branson's Broad Spectrum Cleaning technology puts more powerful ultrasonics to work for you.

For Ultraclean, get Ultrasonics

Ultrasonic cleaning depends upon cavitation, the rapid formation and violent collapse of minute bubbles or cavities in a cleaning liquid. This agitation by countless small and intensely collapsing bubbles creates a highly effective scrubbing of both exposed and hidden wetted parts surfaces. Cavitation is produced by introducing high frequency, high intensity sound waves into a liquid. Branson's design introduces sound in a unique way to produce Broad Spectrum Cleaning, the enhancement of higher power multiple frequencies *in the cleaning bath.* This results in improved distribution of cleaning activity, elimination of potentially destructive standing waves and more precise cleaning. Broad Spectrum Cleaning removes contaminants that defy soaking, scrubbing, steam cleaning and other conventional cleaning methods. You can really *see* the difference!

Today's leading manufacturers, jewelers, lab technicians, optics specialists, doctors and dentists – people who require thoroughly clean parts, tools, instruments and components – rely on Branson ultrasonic cleaning for their toughest, deep-down dirt problems.

Ultrasonic applications for every industry

Ultrasonic power can be used to clean, mix and dissolve. Here are just some of the wide range of current applications for Branson ultrasonic and other cleaning products.

Industry
Gets dirt, grease and manufacturing by-products out of small places where they can cause big problems.
- Switches, gears, relays, motors, precision bearings, metal and plastic parts and assemblies.

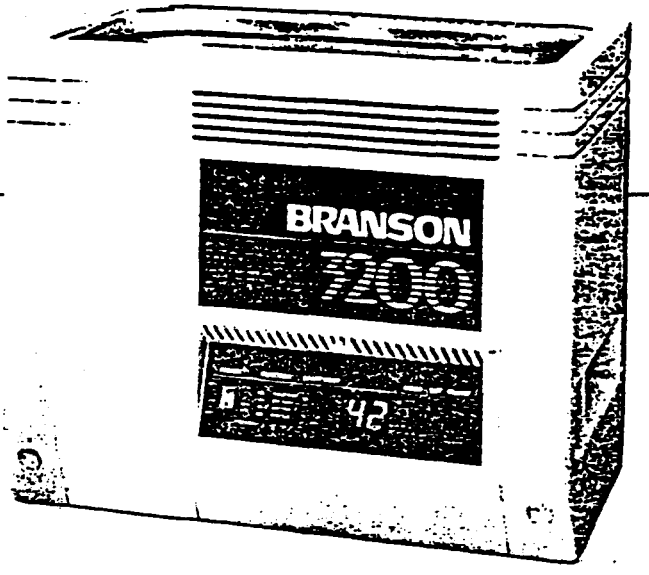
Electronics
Removes flux and contaminants instantly, without damaging sensitive components.
- PC boards, wafers, lapping heads, ceramic substrates, capacitors, packaging components, quartz crystals, high resolution glass plates.

Jewelry and Precious Stones
Brings back shine! Cleans quickly, thoroughly in seconds.
- Watches, clock movements, jewelry and precious stones, intricate settings, chains, charms, coins.

Medical and Scientific Laboratories
Cleans away blood, protein residue and contamination other methods miss. Mixes and degasses.
- Laboratory glassware, test tubes, pipettes.
- Medical instruments, needles, syringe plungers and barrels, surgical instruments, blood oxygenators.
- Optical lenses, contact lenses, eyeglass frames.
- Dental instruments, burrs, dentures, caps, plates.
- Scientific instruments and components.

Branson offers broad choices in ultrasonic aqueous cleaning equipment. A unique benefit of ultrasonic cleaning is its ability to penetrate tiny crevices, complex assemblies and hidden recesses, removing contaminants that defy soaking, scrubbing, even steam cleaning. Where those methods are inefficient or completely ineffective, ultrasonic cleaning is the answer. Our product line begins with a range of small benchtop units with varying capacities and features and ends with individual cleaning modules for custom installations. We also offer modular ultrasonic power supplies, transducers and tanks that you can combine as desired to meet your needs as well as specially formulated water-based ultrasonic cleaning solutions.

Bransonic® Ultrasonic Benchtop Cleaners



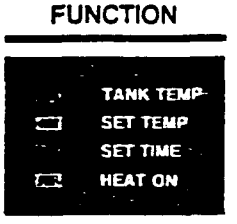
The Bransonic 3200 Ultrasonic benchtop cleaner with full features.

For benchtop cleaning convenience, a Bransonic unit is your go-anywhere workhorse. Choose among five models with tank capacities from ½ gallon to 5½ gallons. Each model is available in four configurations: ultrasonics alone; ultrasonics combined with either heater or timer; or ultrasonics plus thermostat, heater and timer. Digital controls let you program exact cleaning cycle parameters and LED readouts allow for at-a-glance monitoring. The microprocessor-based digital thermostat gives control for applications requiring a specific temperature range.

Increase cleaning ease, productivity and the versatility of your ultrasonic cleaner with Bransonic accessories. Choose among solid and perforated stainless steel insert trays, various stainless steel or polypropylene beakers, beaker positioning covers and tank covers.

More Info?
Write or call for literature on Bransonic Ultrasonic Benchtop Cleaners.

Set cycle temperature and time with the touch of a button.

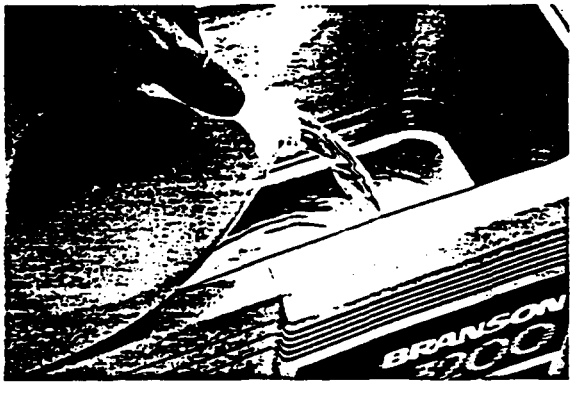


Function display guides your mode selection, making operation easier.

Aqueous Solutions

Branson offers a broad selection of concentrated cleaning solutions for applications ranging from general industrial cleaning to removal of specific soils such as buffing compounds or metal oxides. These water-based concentrates are designed especially for high efficiency soil removal in ultrasonic cleaning applications. Extensive laboratory and field testing has been done to optimize their performance in your ultrasonic system. Just add water and go! Available in quart, gallon, 5-gallon and 55-gallon containers.

More Info?
Write or call for literature on Branson's Ultrasonic Cleaning Solutions.



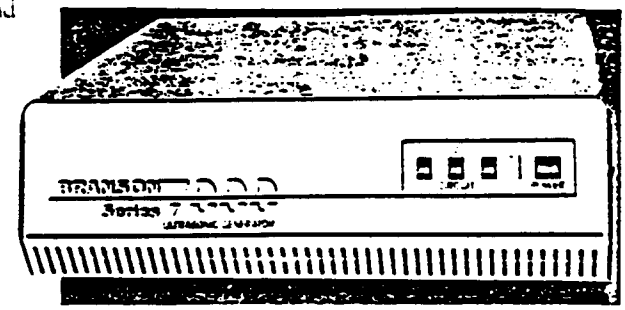
Series 7000 Ultrasonic Power Supplies

art with an ultrasonic power supply to uild your own custom cleaning system, ombining the economy of standardization ith the flexibility of modular design.

The Series 7000 line of modular solid-ate power supplies is connected by RF able to Branson transducerized tanks or mmersible transducers. You can specify a ower supply with from one to four identi-al, plug-in PC boards. Each board powers om 6 to 12 ultrasonic transducers in your oice of 25 or 40 kHz output frequency.

Each board operates as an independent circuit, allowing one power supply to drive several tanks—an economical and space-saving idea.

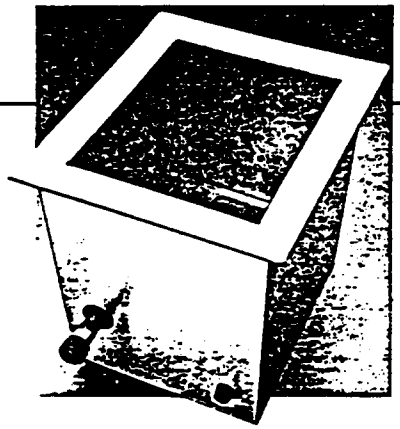
More Info?
Write or call for literature on Branson's Series 7000 Ultrasonic Power Supplies.



Transducerized Tanks

hoose from a wide variety of stainless eel tanks, heated or unheated, with tegral ultrasonic transducers. All are quipped for easy connection to Series 000 ultrasonic power supplies.

fore Info?
/rite or call for literature on Branson's ransducerized Tanks.

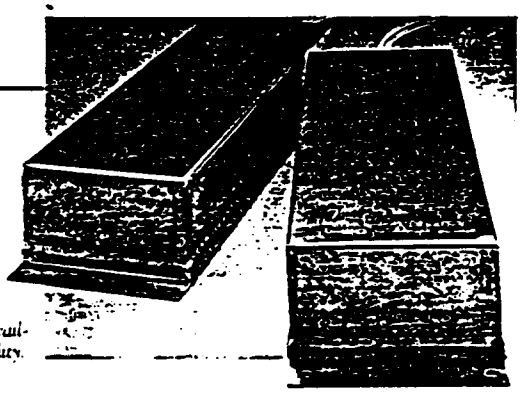


Branson stainless steel tanks come equipped with integral ultrasonic transducers.

mmersible Ultrasonic Transducers

ur stainless steel ultrasonic transducer odules can be placed wherever you need em in your cleaning tanks. These units ve you complete freedom to design ecialized cleaning setups or to upgrade old tanks with new ultrasonic cleaning capability.

More Info?
Write or call for literature on Branson's Immersible Ultrasonic Transducers.

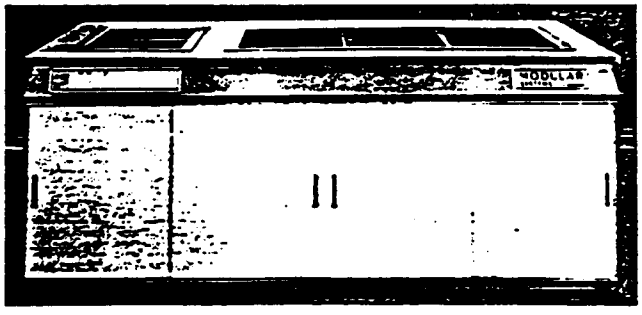


Branson stainless steel immersible transducers are available in four configurations for installation flexibility.

Modular Bench Cleaning Systems

ere is a freestanding cleaning system at you create. Just specify your preferred neup of cleaning units from standard odules. Select from a wide range of off-e-shelf equipment: immersion tanks ith or without ultrasonics, heated pre-ak tanks, spray, rinse or cascade tanks d accessory pumps, heaters and timers. 's the most cost-effective way to build a stomized cleaning system from standard mponents—and makes maintenance a ze. Available only from Branson!

More Info?
Write or call for literature on Branson's Modular Bench Systems.



This typical modular bench configuration consists of an ultrasonic wash unit and a 3-tank cascade rinse.

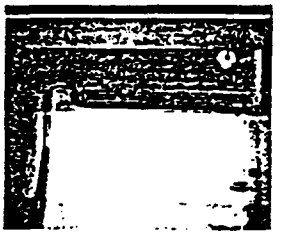
Solvent vapor degreasing is the suspension of workpieces in warm, pure vapors which are created by boiling a solvent specially formulated to remove industrial soils. Because parts are cooler, solvent vapor condenses on the parts, dissolving and washing away soils and grease. When parts reach vapor temperature, they are removed from the vapor for the cleaning cycle. A chiller is used with the degreaser to condense the vapor and optimize solvent reclamation.

The addition of ultrasonics to vapor degreasing adds a powerful enhancement to the cleaning process. By using vapor rinsing and ultrasonic cleaning stages, Branson ultrasonic vapor degreasers meet the needs of manufacturers with especially stringent cleaning requirements. In addition, ultrasonic vapor degreasing is a proven timesaving, laborsaving process that also helps limit direct worker exposure to solvent vapors.

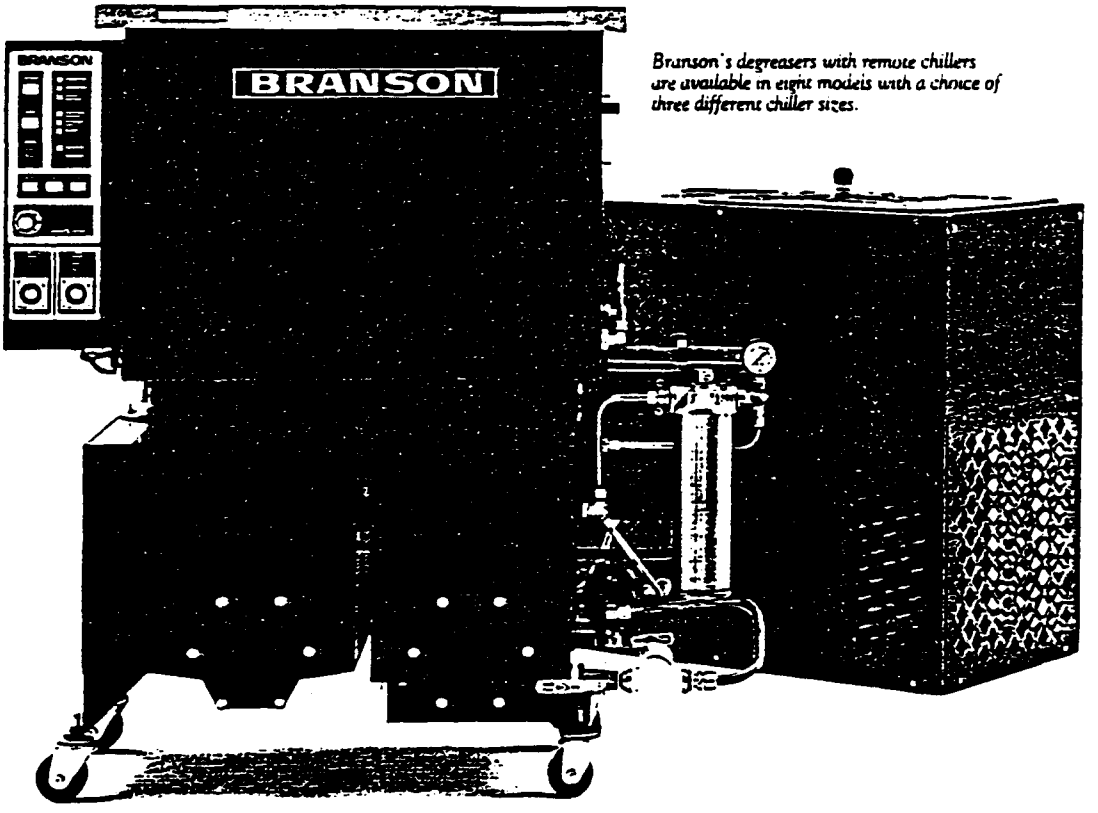
Ultrasonic Degreasers with Remote Chillers

Branson's degreaser line delivers high-volume, high-efficiency industrial cleaning. This line has been designed expressly for cleaning consistency, high throughput rates, operating and service convenience, solvent economy, energy conservation and installation versatility. Each of our three sizes gives you both efficiency and flexibility. Choose among several two-sump degreasers and chiller configurations, depending upon your cleaning and cooling needs. Three chillers are available, all designed for location up to 25 feet from the degreaser – to free up valuable processing space and cut your cooling energy expenditures. In addition, each degreaser has an auxiliary port for ready hookup and compatibility with a Branson automated transport system.

More Info?
Write or call for literature on Branson's Ultrasonic Degreasers with Remote Chillers.

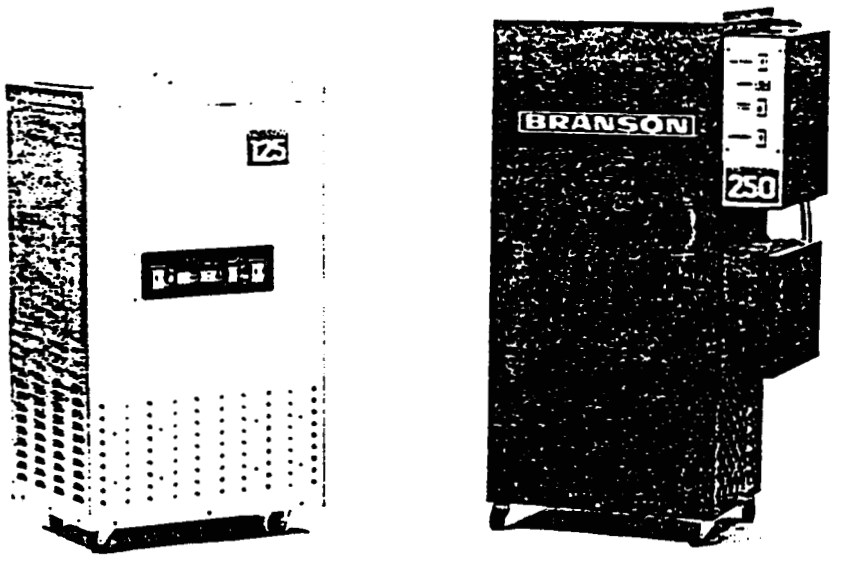


Boiling sump heating elements are offset, giving you fully usable sump depth and greater throughput potential.



Branson's degreasers with remote chillers are available in eight models with a choice of three different chiller sizes.

Portable Degreasers with Integrated Cooling



Branson's B-125 and B-250 Portable Degreasers make on-the-spot degreasing easy and economical.

Branson's portable ultrasonic degreasers are complete, self-contained cleaning systems in compact, portable cabinets. They offer ideal convenience for cleaning components before assembly, laboratory instruments, precision lenses, etc., right at the point of need. All Branson portable degreasers utilize multi-stage cleaning sequences. A typical sequence might consist of vapor rinsing, ultrasonic immersion cleaning, parts drying and continuous solvent reclamation. Portable degreasers are available with solvent capacities of from 2 to 9 gallons.

Standard equipment includes a boiling sump, ultrasonic immersion sump and provisions for solvent reclamation. Units are available with direct expansion refrigeration or water cooling. Optional features include a distillate spray wand and desiccant dryer for use with water-bearing solvents.

More Info?
Write or call for literature on Branson's Portable Degreasers.

Vapor Degreasers with Remote Chillers

For high-volume degreasing needs that do not require ultrasonics, Branson offers a line of non-ultrasonic degreasers with remote chillers. This line gives you degreasing consistency, high throughput rates, solvent economy, energy conservation and installation versatility. Choose among one and two-sump models with one of three remote chillers – designed for location up to 25 feet from degreaser – to free up valuable production space. Each non-ultrasonic vapor spray or vapor spray immersion degreaser has an auxiliary port for instant compatibility with a Branson automated transport system.

More Info?
Write or call for literature on Branson's Degreasers with Remote Chillers.

Solvent Recovery Stills

Branson solvent recovery stills provide automatic distillation of a variety of vapor degreasing safety solvents. They can be used for stand-alone batch reclamation of solvents, or plumbed directly to Branson vapor degreasers. In a tandem setup, the degreaser sumps stay cleaner because contaminated solvent is continuously cycled to the still and replaced in the degreaser by fresh solvent. Stills and compatible chillers are available in sizes to match Branson degreaser models.

More Info?
Write or call for literature on Branson's Solvent Recovery Stills.

BRANSON AUTOMATED TRANSPORT SYSTEMS

Branson automated transport systems are ideal for labor-free transfer of parts in batches through cleaning or processing lines. Basket movements are programmed for hands-off automatic cycling through the cleaning sequence. Transport technology can save time and expensive solvent by minimizing solvent emission losses with smooth and consistent transfer of baskets through the vapor zone.

Branson automated transports are material handling systems that install over or behind your present cleaning or processing line. These micro[illegible] based [illegible] are smart and flexible. They accept your instructions [illegible] programmable [illegible] remember them with simple commands (self-learning), store as many as ten different programs, check out problems (self diagnosing), control auxiliary equipment (like turning off and on ultrasonic tanks) and protect against power loss (memory backup).

A lightweight, hand-held programmer allows you to program with a simple walk-through. Just move the transport head [illegible] remembers [illegible]

[illegible] programmed [illegible] consistent repet[illegible] [illegible] manually [illegible] select another [illegible]

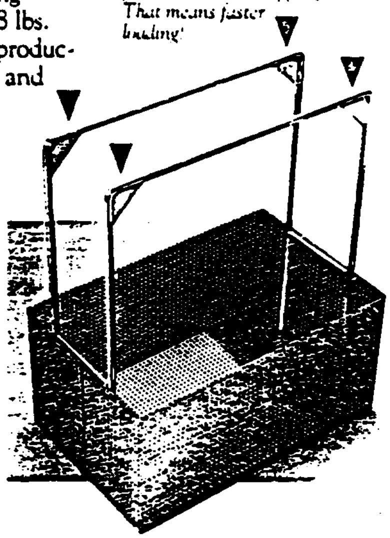
[illegible] processing needs [illegible] transport system. You can extend the rail [illegible] 40 feet and install multiple transport heads that communicate with each other.

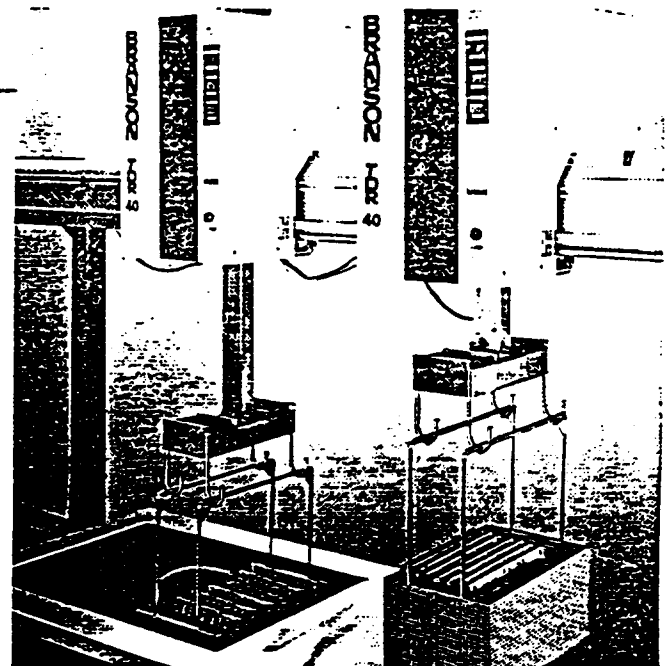
Overhead Transport System

This system is a high capacity system for general industrial parts cleaning operations. The transport heads ride on an overhead rail supported by a free-standing frame. Maximum load capacity is 88 lbs. per head, allowing large batches of production components to be gang-loaded and cleaned together.

More Info?
Write or call for literature on Branson's TDR-40 Transport System.

Branson's transport systems employ positive, four-point pickup which allows even unbalanced baskets to be processed without tipping. That means faster loading!



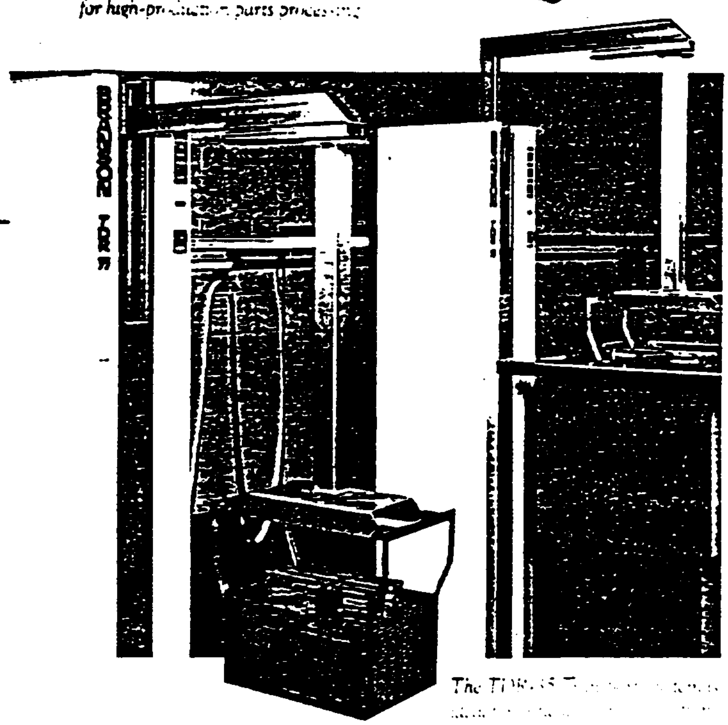


The TDR-40 Transport System [illegible] designed for high-production parts processing.

Cantilevered Transport System

This transport system sidesteps overhead contamination by eliminating moving parts over the cleaning line, making it the ideal system for clean room processes. The transport heads ride on a track behind the line with the rigid arms supporting the parts baskets cantilevered out over the cleaning tanks. Maximum load capacity is 77 lbs. per head.

More Info?
Write or call for literature on Branson's TDR-35 Transport System.



The TDR-35 [illegible]

BRANSON SERVICES & FACILITIES

Branson Service

Branson [illegible] with extensive "software" – the industry's most extensive sales and service network. When you purchase a Branson product, you have the resources and expertise of hundreds of Branson clean-tech people at your disposal. The chances are excellent that we can, right now, give you some answers to your most pressing cleaning problems.

Branson Application Services

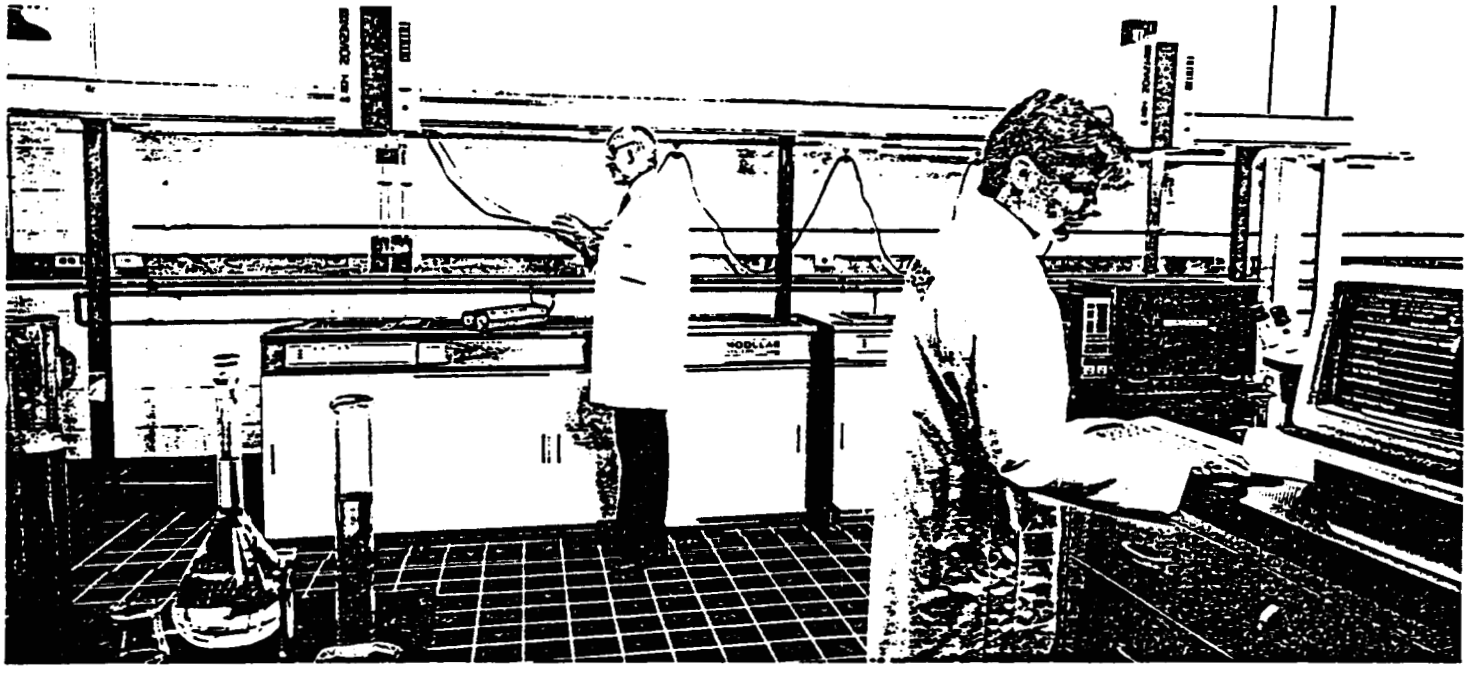
If you have any questions about your present equipment or how your cleaning needs can best be met, talk to a Branson representative before you make a process commitment or an equipment investment. We'll be glad to help. Contact the Branson [illegible] representative in your area for [illegible] profession[illegible] advice.

A Branson representative will review the specifics of your application with you, including the size and construction of workpieces, desired processing throughput rate, types of contaminants present, and the degree of cleanliness required. We will be able to recommend an appropriate process or system that meets your space and budget requirements or suggest further study, if necessary, in the Branson Applications Laboratory.

Cleaning Applications Laboratory

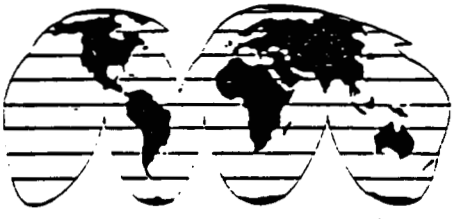
Can your part be cleaned quicker and more thoroughly? Are there safer solvents [illegible] transducers? [illegible]

In our process [illegible] cleaning laboratory, these [illegible] be answered by [illegible] from your [illegible] our tough [illegible] can analyze [illegible] ing to your [illegible] that outlines [illegible] cleaning media, process and equipment. Our Cleaning Applications Laboratory services are free and can save you endless expensive trial-and-error experimentation. Do let us help you with any cleaning problem you have.



The Branson Cleaning Applications Laboratory is ideally equipped for test cleaning samples from your process and finding answers to your toughest cleaning problems.

It's important to know that the machine you buy here and ship there will have Branson service waiting for it – even if "there" is halfway around the world. The same is true if you change production sites in the future and want to relocate your Branson equipment. Branson service is available everywhere you go.



NATIONWIDE, WORLDWIDE BRANSON SERVICE

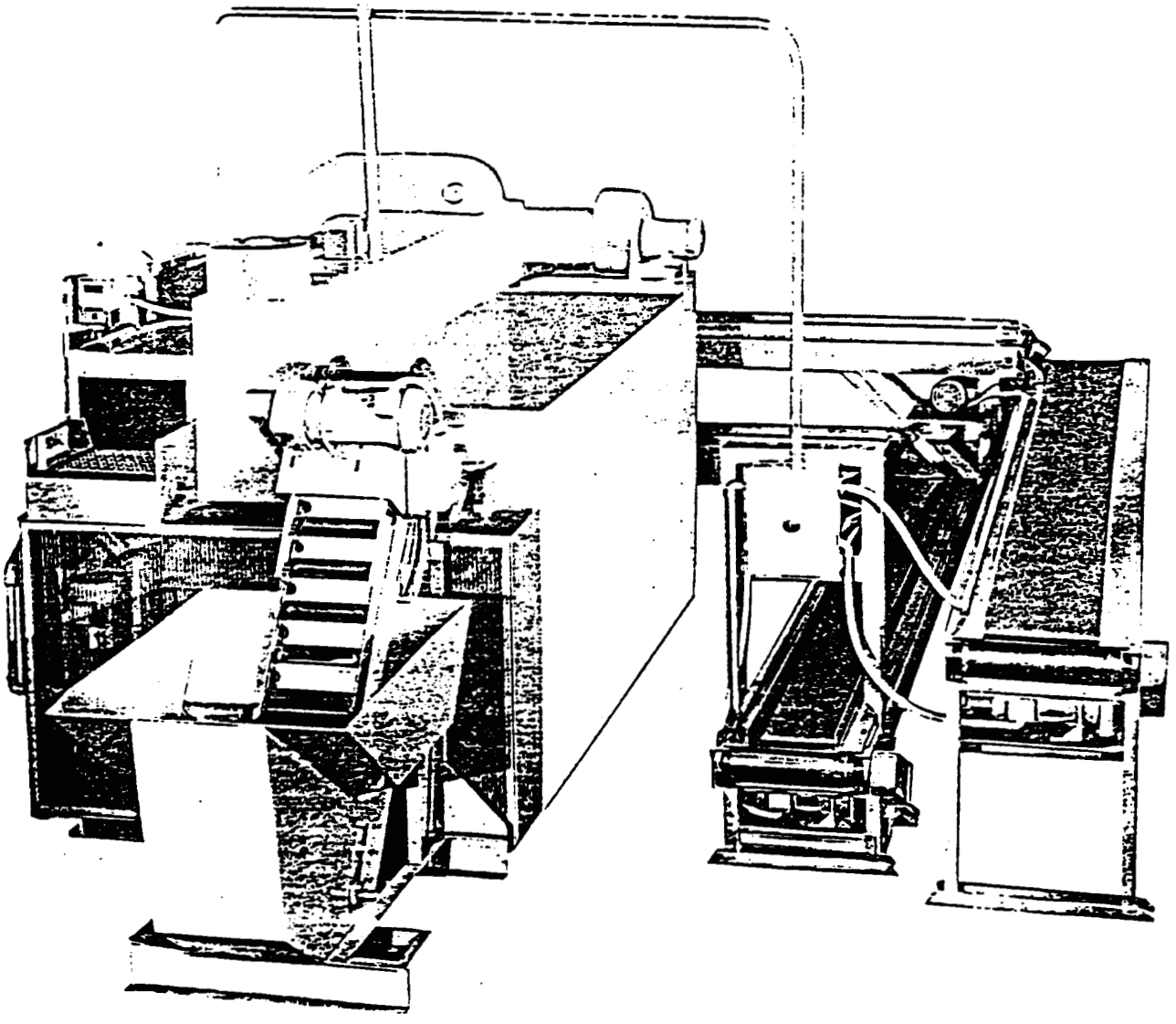
Branson is the first name in ultrasonic cleaning, with sales and service offices in most major cities throughout the world. They are supported by facilities in the United States, Europe and Japan.

BRANSON ULTRASONICS CORPORATION

Eagle Road, Danbury, Connecticut 06810-1961 (203) 796-0400 TLX. 643743 FAX. 203-[illegible]
Branson Europa, Soest, The Netherlands – Branson Canada, Scarborough, Ontario
Branson Japan, Tokyo, Japan

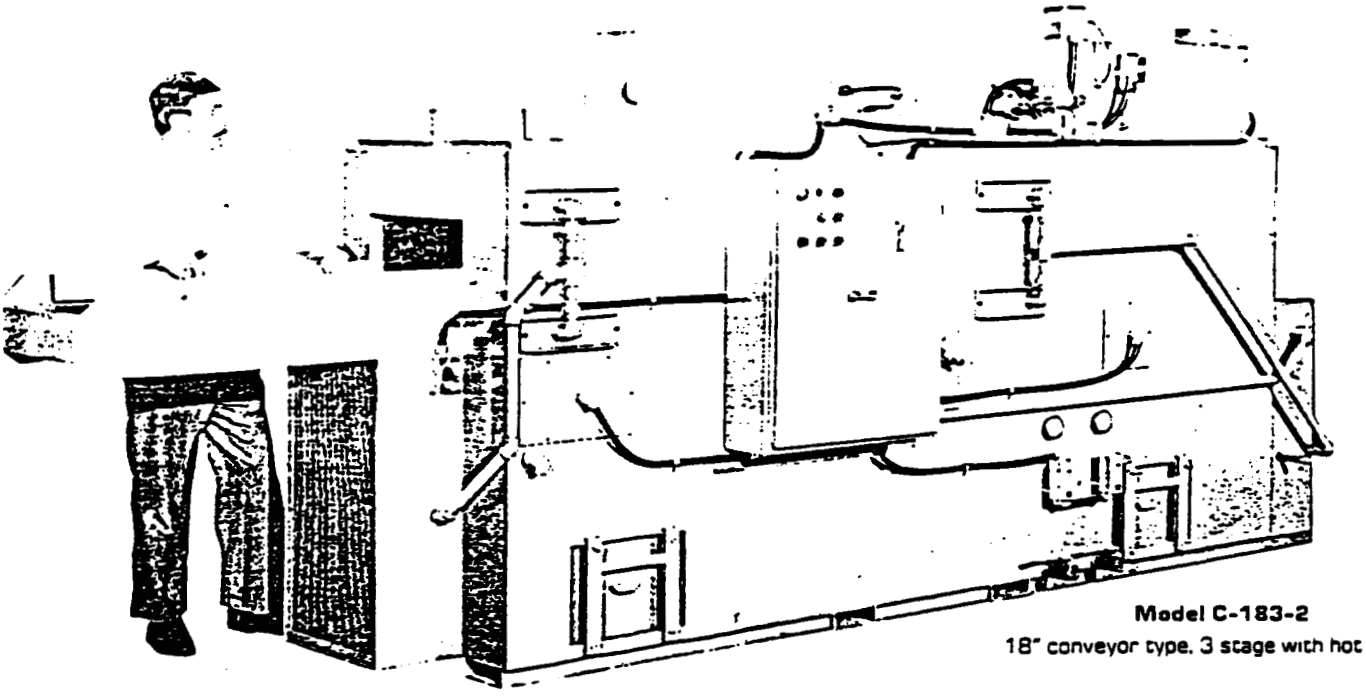
Printed [illegible]

FLO-MATIC CORPORATION



PARTS WASHERS & WASHING SYSTEMS

PARTS CLEANED, DRIED AND INHIBITED FOR LESS THAN ONE-HALF CENT PER POUND WITH FLOMATIC WASHER SYSTEMS!



Model C-183-2
18" conveyor type, 3 stage with hot air dry.

,perating Efficiencies & Benefits

When used in line, or as a central station, the FloMatic otary drum type washer will produce clean, dry, inhibited arts for less than one-half cent per pound — including perator cost. FloMatic Engineering and Manufacturing ncompass a multitude of details that collectively con-ribute to make the FloMatic systems among the most ffective and cost efficient parts washing machines vailable to the industry.

Heavy gauge, large tanks extend tank life and lengthen uid change intervals. Large input chutes permit con-nuous, clog-free charging; and the specially designed rum assures properly dried parts and smooth discharge.

built-in torque limiter protects the drive against ccidental jamming.

The configuration of FloMatic machines allows maxi-ium installation flexibility. Operating and service require-ients are accommodated from no more than three des of the machine. Consequently, FloMatic washers ay be butted against a wall or other machinery for ptimum space use and production efficiency.

On the front cover:

Model DT-243-2-C-143-2

Combination drum/conveyor with three stages, parts loader, pan and parts return conveyor. Handles parts from small as #0-80 screws to as large as 2".

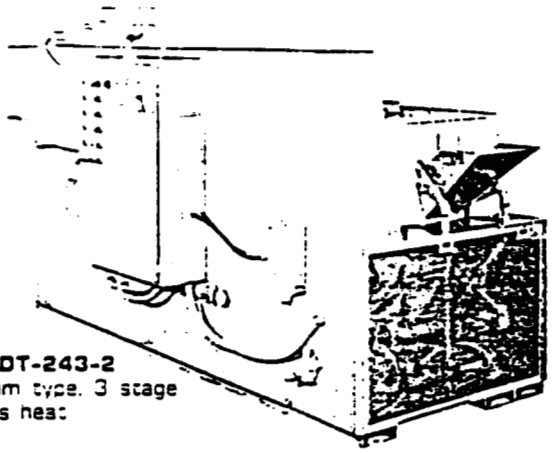
Why Flo-Matic?

FloMatic Corporation manufactures drum type, conveyor type, and stationary type parts washers and systems. Drum and conveyor types can be combined into a single unit for simultaneous parts and pan washing.

Drum washers are available with one, two, or three stages —wash; wash/blow dry; or, wash/rinse/blow dry. Hot air drying is also available as an option on the two and three stage washers. They are available with five standard drum sizes: 15", 19", 23", 30" and 38".

Other design features and options that contribute to the performance and efficiency of FloMatic systems include:

- Three types of washing action: Immersion, agitation, and spraying.
- Custom designed helix — the lead of the helix is calculated to meet the washing/production requirements of the part.
- Continuous welded helix. A continuous weld secures and seals the helix to the drum interior, prevents snagging of small parts, and subsequent parts mix.
- Drum tumblers, if necessary, are added to increase the tumbling action to meet washing requirements of the part.
- Ample size tanks permit longer production time between tank cleanout.
- Hatch-type cleanout doors simplify and shorten the cleanout operation.
- Low maintenance. FloMatic machines are built to be as nearly maintenance free as possible. When maintenance is required, components are easily accessible.



Model DT-243-2
23" drum type, 3 stage with gas heat

Construction & Seviceability

Every FloMatic machine is constructed of heavy gauge metal to support continuous, long term operation. Standard rotating and load bearing components are selected for their precision engineering, high performance, and long wear life qualities. They are provided by major, reputable manufacturers. Replacement components are readily available through local industrial parts suppliers. Electric controls are designed to machine tool quality, with reliable NEMA 12 JIC enclosures.

Regular maintenance procedures are facilitated in FloMatic Engineering. The drive components are prelubricated, and grease fittings are located for quick and easy access. Drum bearings are accessible from outside the machine for easy replacement.

Pumps and drives are housed in their own compartment —accessible, and out of the way. The pumps can be easily removed for servicing simply by removing two bolts and two couplings.

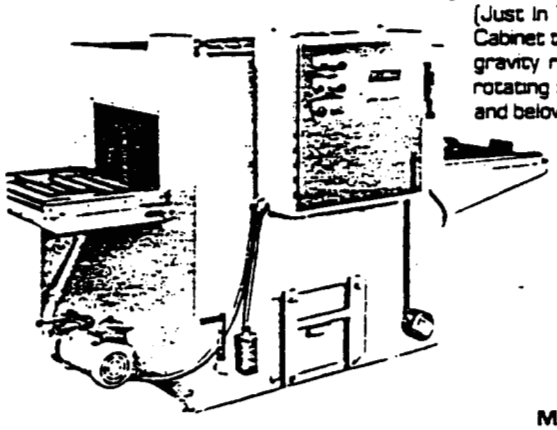
The large, hatch-type, gaskedeted cleanout doors save time, and facilitate regular cleaning.

Standard Features

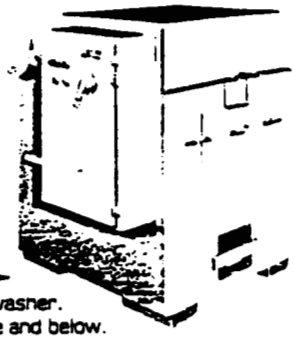
Electrically heated water, thermostatically controlled 200° F.
Suitable for bio-degradable detergent with rust inhibitor.
7-day, 24-hour timer for pre-heating during off-peak hours, and shutdown during weekends and holidays.
Wash and rinse stages feature part immersion and high pressure water spray.
Pump intakes and heaters baffled against contamination.
NEMA 12 electrical enclosure with fused disconnect.
480V, 3 phase, 60 Hz operation.
115V pushbutton control.
High pressure, high flow blow-off (2 and 3 stage).
Heavy duty industrial construction for long life and minimum maintenance.
¼" steel plate tanks with double welded seams.
Gasketed tank cleanout door.
Weir dam for overflow skimming.
Drum tumblers, if necessary, to meet tumbling requirements.
Drum helix pitch as required to meet proper part washing.
Clean exterior lines for safety and easy cleaning.
Standard, off the shelf components.
Constructed for fast, easy maintenance.
Epoxy VistaGreen enamel.

Options & Accessories

Complete tank insulation.
Oil skimmer, disc type.
Automatic level control.
Low water level safety cut-out.
Gas or steam water heater.
Gas or steam hot air dryer.
Chip collecting systems.
Special drum material, thickness and perforations.
Variable speed drive.
Cold water wash.
Part loading/unloading systems.
In-line pump filters.



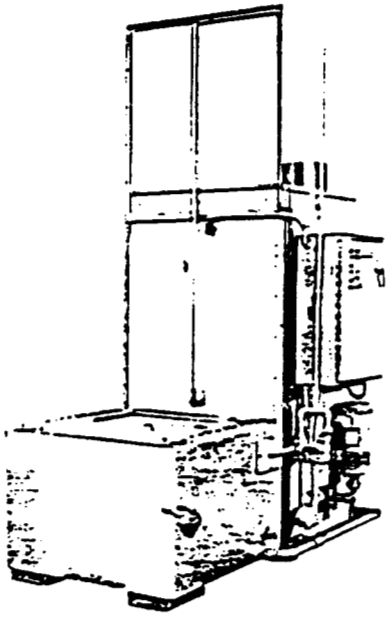
▲ JIT Rotary
(Just In Time)
Cabinet type washer with gravity roller conveyor & rotating spray heads above and below conveyor.



Model CT-141 ►
Cabinet type pan washer.
Spray heads above and below.
Washes two pans at a time. 60 pans/ hour.

Quality

FloMatic washers and systems are designed and built to the highest quality standards found in the industry. Specific attention is given to energy efficiency, design detail for long, thorough washing service, and serviceability. Only standard components of reliable, reputable manufacturers are used. And, when service is required, parts are readily available from local suppliers.



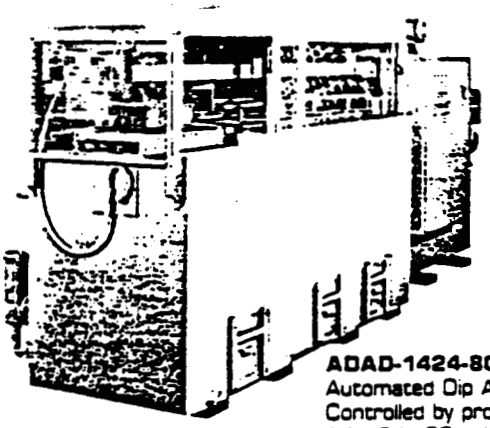
Model CT-32 ►
32" cube parts basket, cabinet type with rotating spray heads above and below the parts.

Dip Agitate Systems

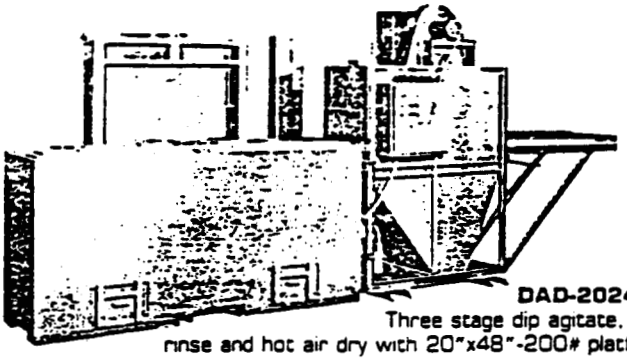
The design goal of Flo-Matic washing systems is to obtain maximu cleaning effectiveness while meeting the production requirements of t user. This requires the proper balance of washing time and wat temperature, and the selection of a cleaner of appropriate strengt

Some parts require immersion, or soaking, in the cleaning fluid in orde to adequately penetrate and release the soils. Other parts may be co figured such that soaking, and even spraying, cannot flush out the so Our dip-agitate is designed to overcome these problems.

The Flo-Matic dip-agitate washers are engineered to meet your need — from very large parts handled one at a time to small parts containe in a mesh basket. They are available in single or multistage system



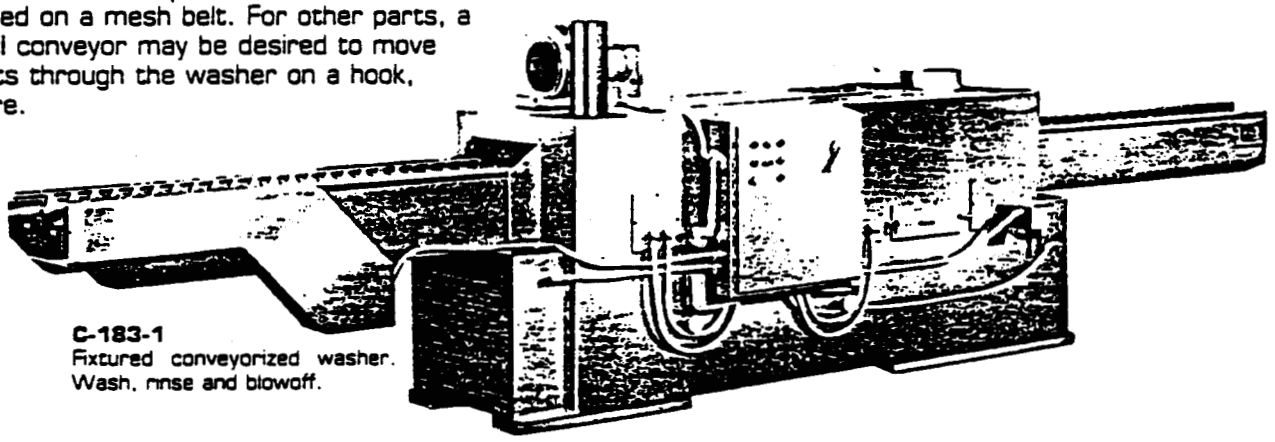
ADAD-1424-80
Automated Dip Agitate with dryer. Controlled by programmable controller 14"x24"-80# platforms.



DAD-2024-20
Three stage dip agitate, was rinse and hot air dry with 20"x48"-200# platform

Conveyor Type Systems

High production cleaning is best achieved on a conveyor type spray washer. Washing/flushing action is achieved from multiple directions through fixed heads or rotary spray heads. The conveyor system is designed to accommodate the part. Parts that hold their position and drain well are best processed on a mesh belt. For other parts, a monorail conveyor may be desired to move the parts through the washer on a hook, or fixture.



C-183-1
Fixtured conveyorized washer. Wash, rinse and blowoff.

OTHER MACHINES AVAILABLE FROM FLOMATIC TO MEET YOUR PARTS CLEANING REQUIREMENTS.

Conveyor belt washers for large parts, or parts in baskets (2 or 3 stage)
Tote pan/tub washers (2 or 3 stage)
Walking beam type for large parts
Washers/dryers for special applications
Dip agitate systems
Steel belt loaders
Return conveyors
Vibratory hoppers

FLO-MATIC CORPORATION

Flo-Matic Corporation
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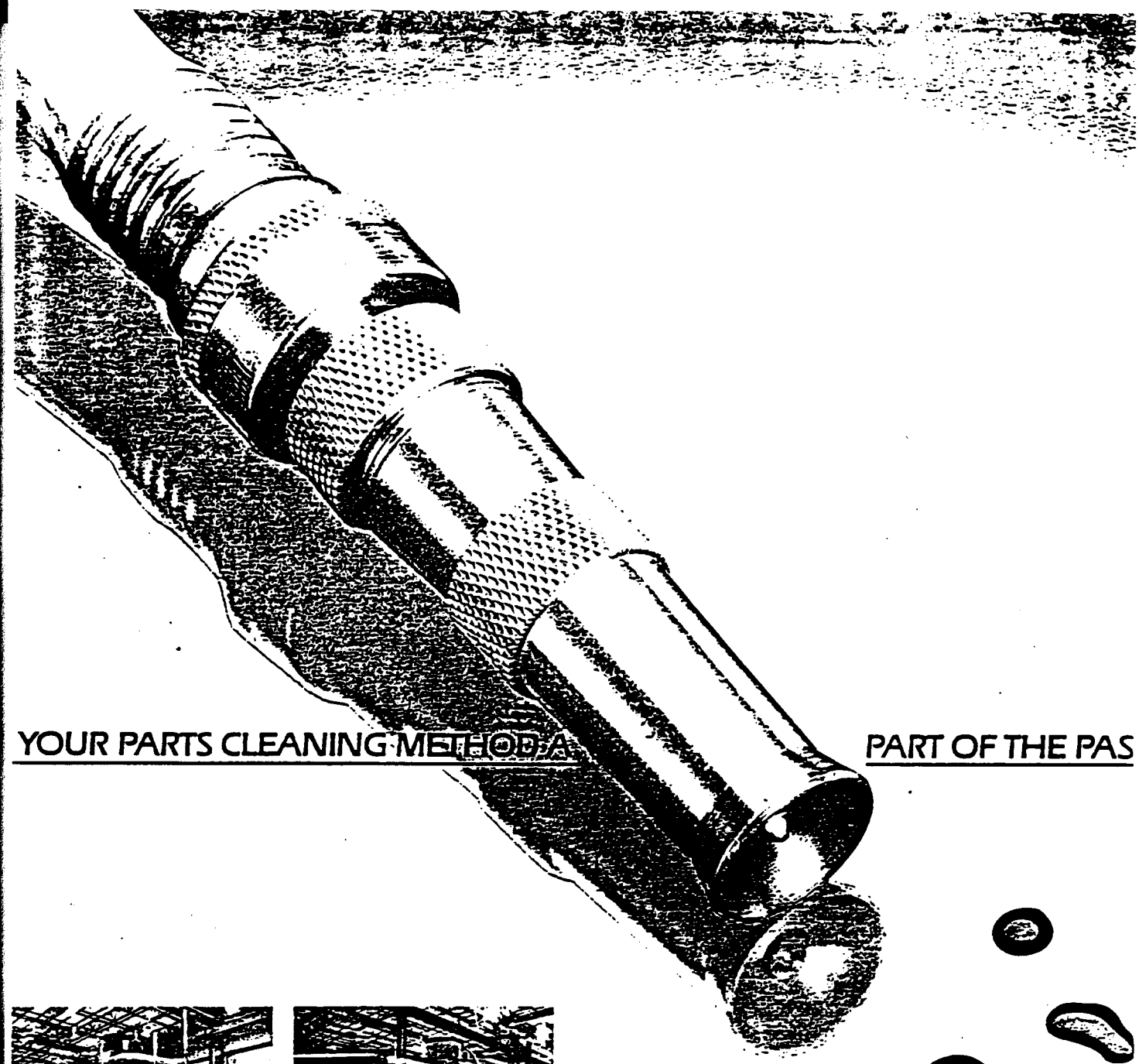
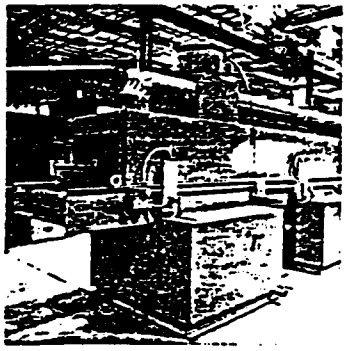
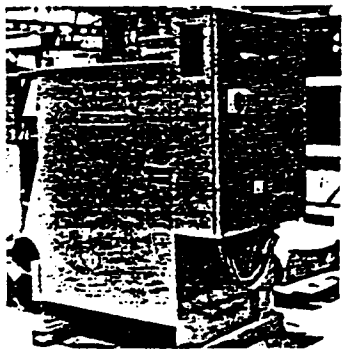
Belvidere, IL 61008
Phone: 815/547-5650
Fax: 815/544-2287

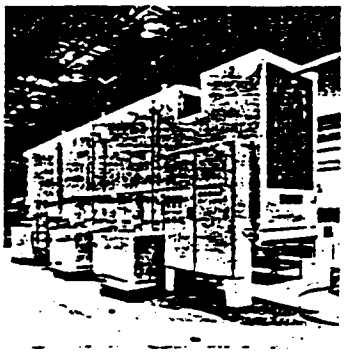
YOUR FLO-MATIC REPRESENTATIVE



YOUR PARTS CLEANING METHOD A PART OF THE PAS







LET STOELTING BRING YOU CLEAN UP TO DATE

Oil. Chips. Abrasive residues. Shop dust. All part of everyday manufacturing. Yet all can grind away at your product's quality, performance, and appearance. And your bottom line.

A custom Stoelting monorail washer with PLC controls and wash, rinse, dionized rinse, and blow-off modules.

Stoelting has developed the technology that sprays away these problems. Better than any other parts cleaning method. So you're assured of the chip-free, dirt-free, grease-free parts vital for accurate fixturing, coordinate measurement, assembly and other post-machining operations.

STOELTING'S SPOTLESS REPUTATION

Since 1905, we've been innovators in industrial and commercial products. Because Adolph, Otto, and Gustave Stoelting built more than dairy equipment in those early years. They built a reputation for researching and developing ideas and equipment to solve problems and satisfy customer needs.

We put that same dedication to work when we started manufacturing industrial parts cleaners in 1952. Since then, companies like Texas Instruments, Digital Equipment, Sunbeam, Bendix, and others have depended on Stoelting for innovative cost-effective solutions to their industrial cleaning problems.

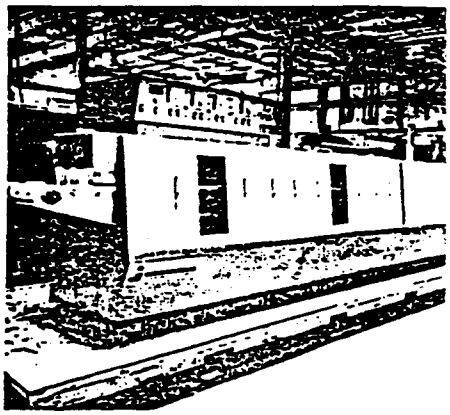
And today the Stoelting name is known clean around the world. As an engineering innovator and leading supplier serving diverse industries: the dairy and cheese making industry, commercial and institutional foodservice markets, electronic circuit board manufacturing, industrial manufacturing, and factory automation.

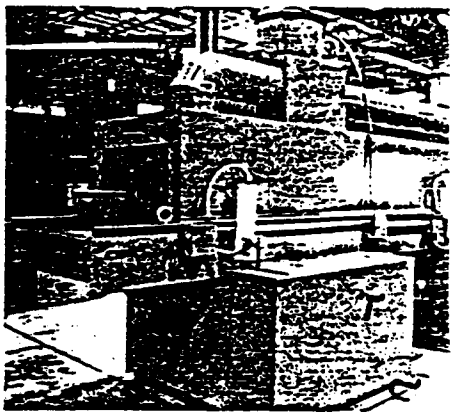
MAXIMUM CLEANING EFFICIENCY WITH MINIMUM MAINTENANCE

No industrial parts cleaners clean more effectively. Because our Easy Clean Spray System delivers a high volume, high impact spray. Which blasts manufacturing residues free — even in blind holes and pockets.

And the system that cleans better also helps clean itself. Its unique no nozzle V-shape apertures flush out

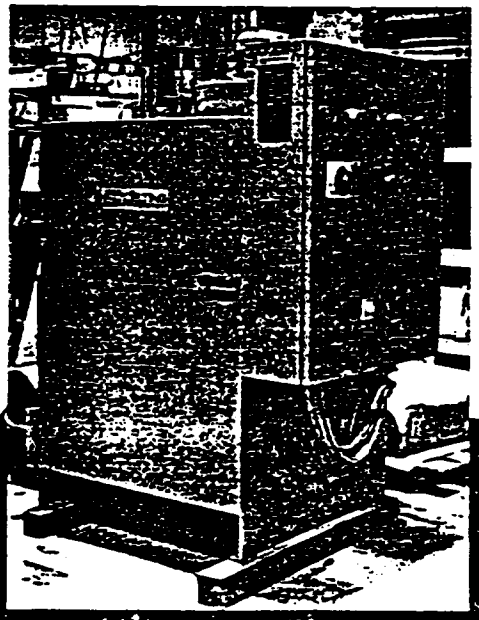
Aqueous circuit board or small component washer with wash, rinse, blow-off and dry modules.

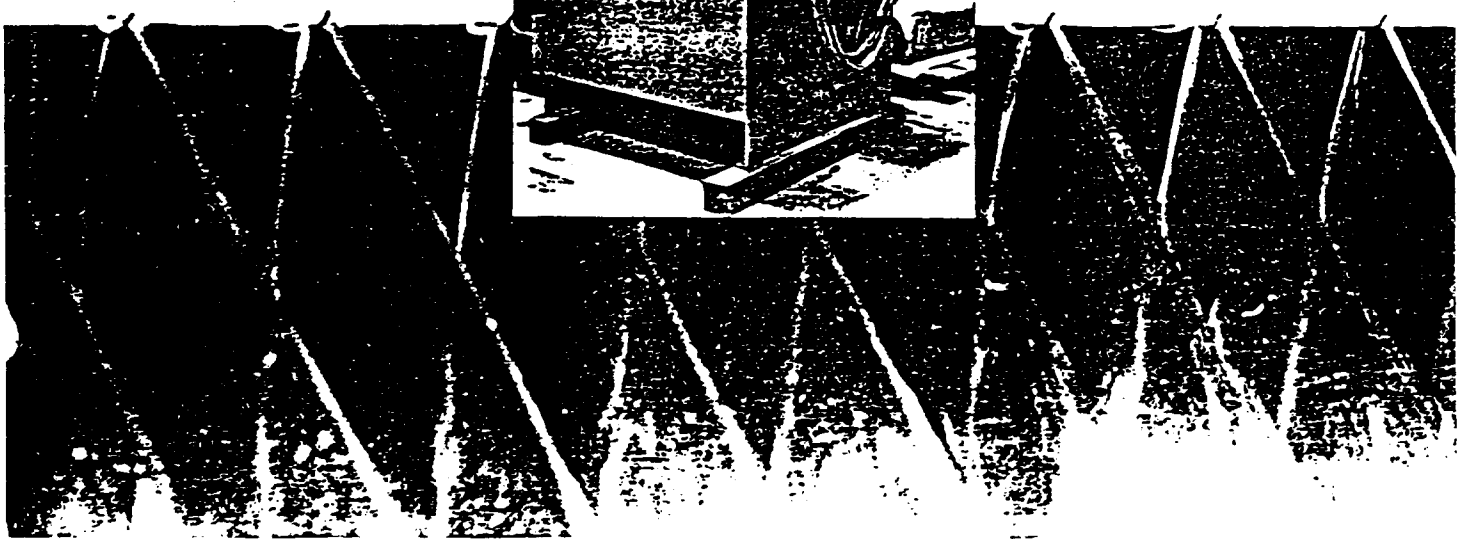




A high volume production conveyorized washer, available with multi-stage blow-off and drying.

Small batch washers suit the cleaning requirements of lower volume applications.





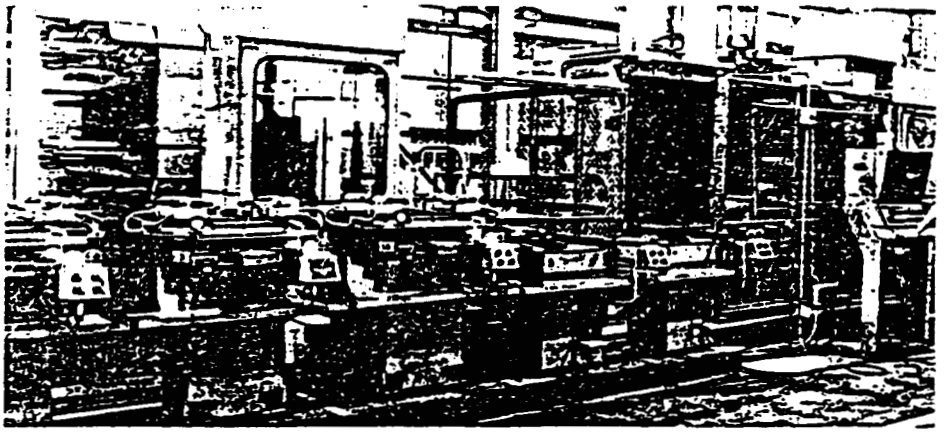
precipitated solids that plug up other systems . . . making the Easy Clean Spray System perpetually self cleaning.

Stoelting's cutting edge technology has also minimized the down time needed for day-to-day maintenance. You can flush out the entire internal spray system simply by turning a valve. Clean out the efficient Filter System in two simple steps. And be back cleaning parts in less than five minutes.

IF YOU MAKE IT, WE CAN CLEAN IT. BETTER.

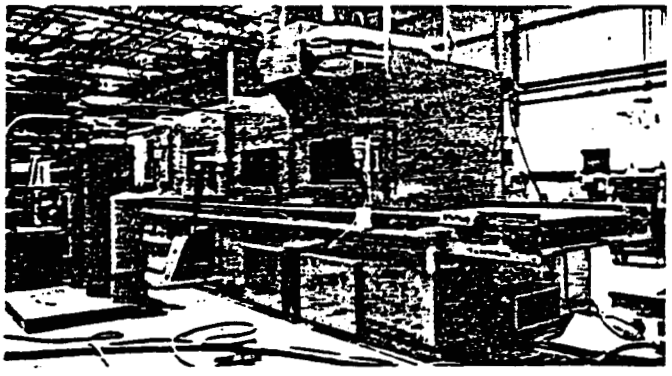
No matter what you manufacture, from engine blocks to electronic circuit boards, from plumbing fixtures to pots and pans, Stoelting will turn your cleaning problems into profitable solutions.

We manufacture a broad line of standard parts cleaning systems. Our line of batch washers, available with payload capacities from 450 pounds up to 3 tons, feature a fully automatic cleaning cycle using water and nontoxic additives. For fast, efficient cleaning without hazardous chemicals. Without fumes. And one-man operation for minimal labor costs.



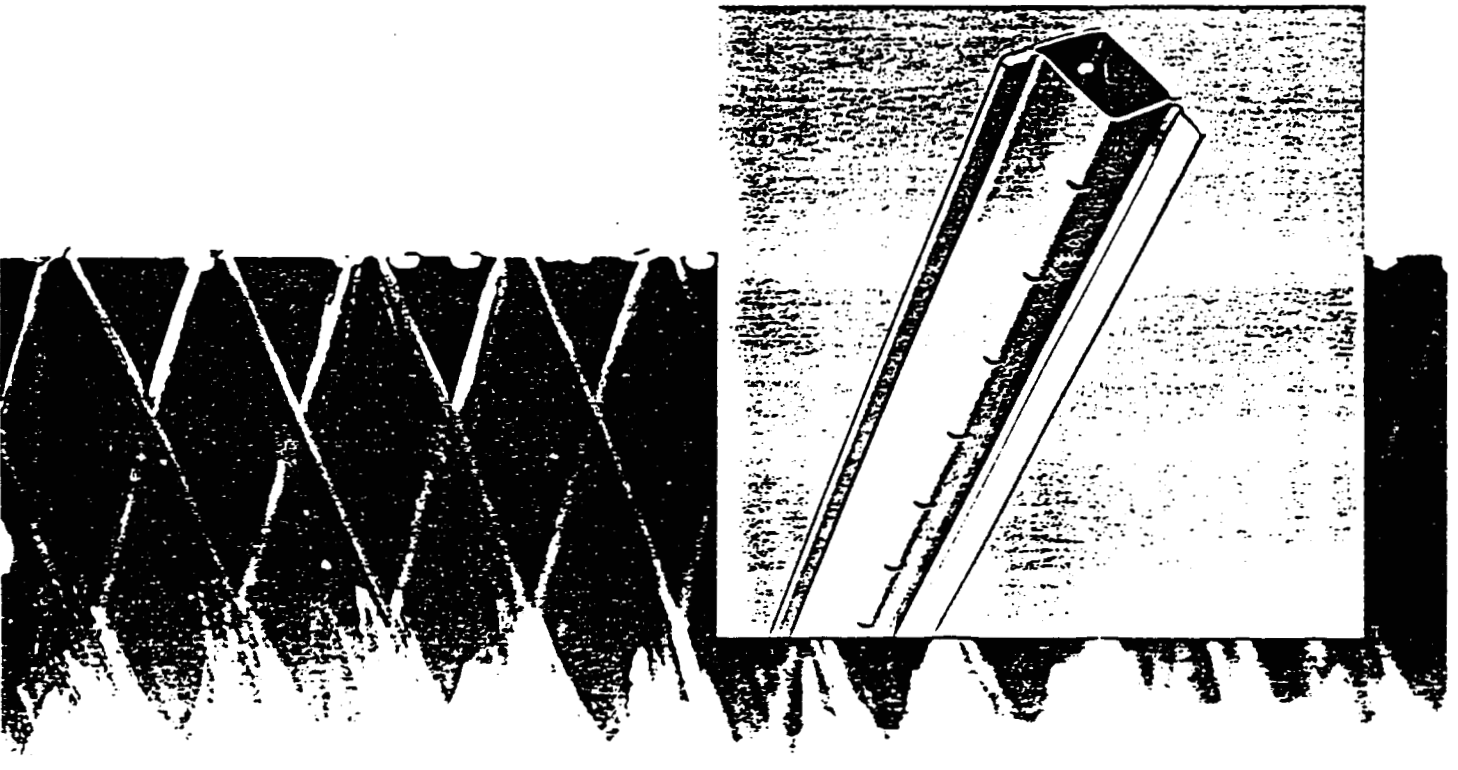
A Stoelting FMS batch washer integrated into an in-line flexible manufacturing cell.

A multi-stage conveyorized washer of stainless steel construction.



Our conveyorized in-line washers are ideally suited for high volume continuous production. In this type of washer, parts are loaded on one end of the machine and cleaned as they pass through. Rinse, rust preventative, and drying requirements are options provided through our modular design concept.

So whether you do small scale hand assembly or use a state-of-the-ar flexible manufacturing system, we have standard parts cleaning systems just your size and style. Or we will custom design and build one specifically for your needs. Incorporating all the same technological advances that have mad Stoelting the industry's cleaning resource.



THE INDUSTRY'S RESOURCE . . . YOUR RESOURCE

ANALYSIS AND TESTING

Consider your toughest cleaning problem. Send us a sample part and outline your requirements. Our technical personnel will analyze your application, conduct test cleaning, and provide you with a report and recommendations. No obligation. It is part of the service.

ENGINEERING

Our staff of engineers and design specialists take your cleaning problems and turn them into profitable solutions. Stoelting's years of experience in industrial cleaning, coupled with extensive knowledge of manufacturing technology, computer operations and automation, make us uniquely qualified to integrate the critical cleaning function into your manufacturing system, large or small. We utilize CAD, and offer in-house capability to develop software for PLC's, and our computerized systems are MAP compatible.

MANUFACTURING CAPABILITY

Stoelting's 145,000 square foot manufacturing facilities, situated on two plant sites in Kiel, Wisconsin, are state-of-the-art for the manufacture of industrial parts cleaning equipment. Our years of experience in fabricating and welding food grade stainless steel is enhanced today by plasma arc cutting capabilities and solid-state controlled gas metal arc welding. And our factories house the latest CNC machine tools for turning, milling and punching.

Located just north of Milwaukee, Wisconsin, Stoelting, Inc., has ready access to sea ports, interstate highway systems, airports and railway systems.

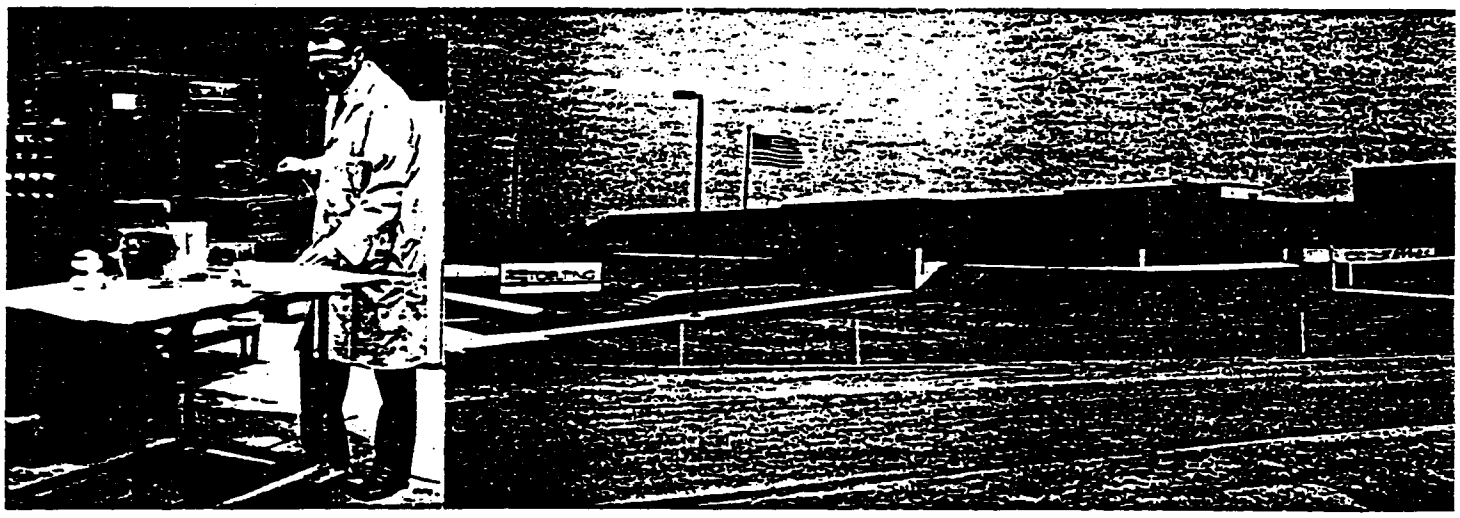
Stoelting offers complete PLC or software programming capabilities.

DELIVERY AND AFTER-SALE SERVICE

Our Marketing Services Department follows your order through from design to manufacturing and delivery. Keeping you informed as to the progress of your project. Meeting with Purchasing, Manufacturing, Engineering, and Production Scheduling to track the detailed status of your project. Assuring that all delivery requirements will be met. The personalized service provided by our Marketing Services Department continues through follow-up on installation and start-up services. Our field service team is your ongoing resource via after-sale programs.

Interested in making a Stoelting industrial parts cleaner part of your future? Call us toll free at 1-800-558-5807 for more information.

Stoelting technical personnel will evaluate your cleaning requirements.

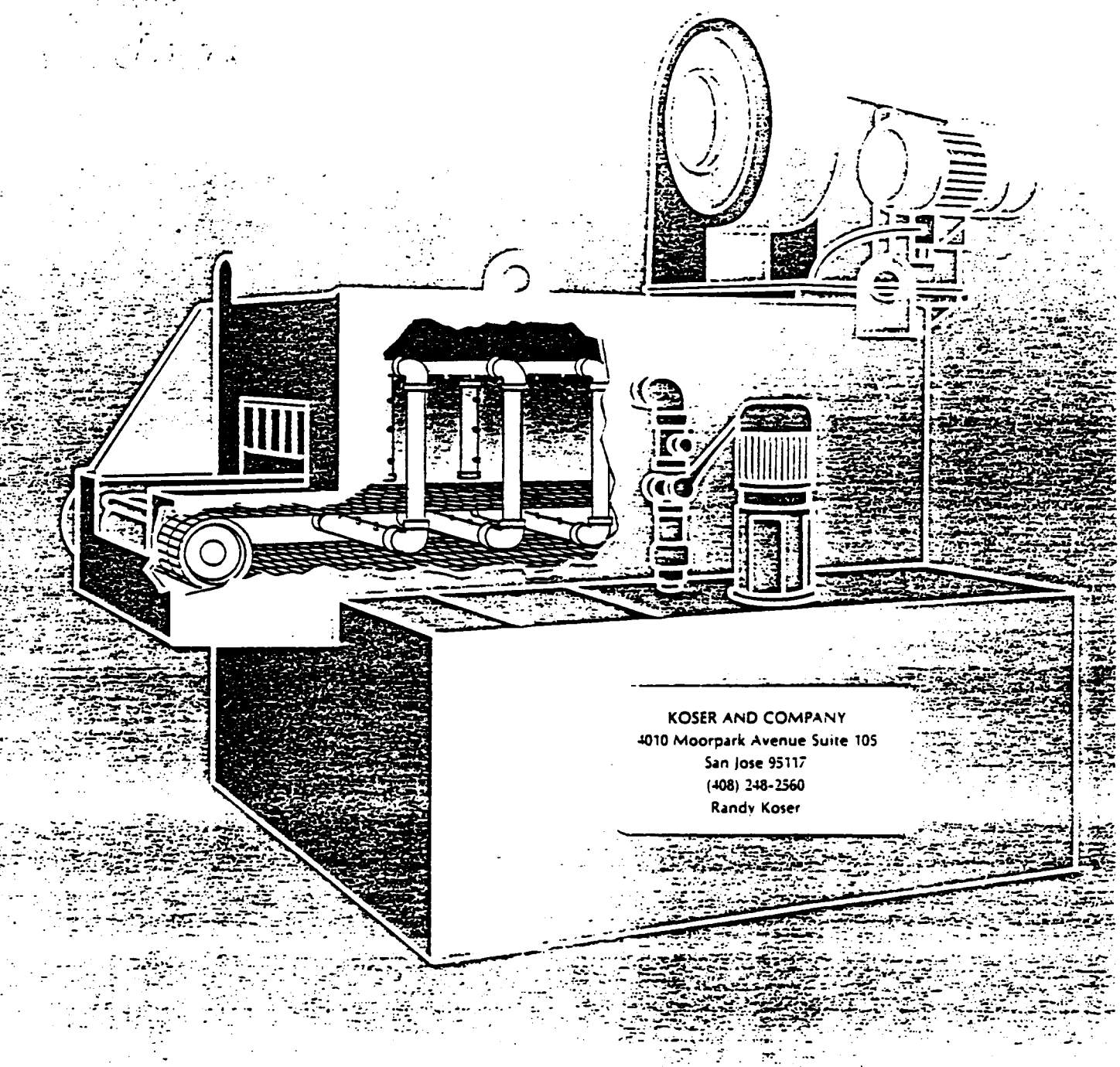


STOELTING

502 Highway 67, P.O. Box 127, Kiel, WI 53042 • (414) 894-2293 • Telex: 510-388-9511 • Toll Free 1-800-558-5807

PROCLEAN™
by RANSOHOFF

Conveyor Series



KOSER AND COMPANY
4010 Moorpark Avenue Suite 105
San Jose 95117
(408) 248-2560
Randy Koser

Conveyor Series

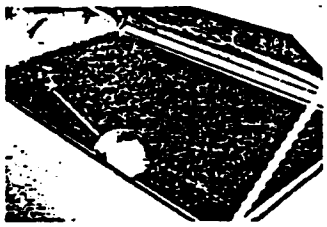
Here are the standard features that should your parts cleaning equipment requirem...

Parts Washers That Offer You Choices. You get the economy of pre-engineering and the flexibility of adding innovative Ransohoff features.

- You choose the features that match your parts washing requirements.
- Replace chlorinated solvent methods of cleaning. Eliminate the environmental and personnel hazards associated with solvent degreasing systems.
- Ransohoff engineering, sales and service staff personally insures the successful installation and ongoing support of your machine.

☐ *Quick Jet Spray Nozzles*
Stainless steel. Change nozzles in seconds without tools. A simple push and quarter twist to install. Simple to do even in difficult to reach areas. Automatically aligns spray pattern. Eliminates wrenches and reduces nozzle cleaning time.

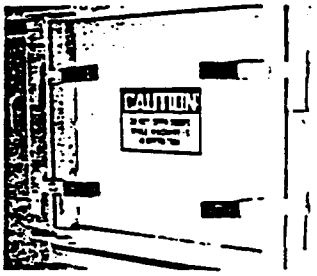
☐ *Tank Clean-Out Lids*
Stainless steel channel type vapor seals are designed to prevent steam from escaping into the surrounding area. Stainless steel hinges and cover lids are provided to enhance equipment longevity.



☐ *Automatic Tank Level Control*
Maintains proper solution level, automatically adds make-up for evaporated liquid, eliminates pump cavitation, assures adequate spray on parts.

☐ *Conveyor Drive Torque Limiter*
Easily adjustable torque settings. Durable and compact. Protects the conveyor drive components in the event a jam condition occurs.

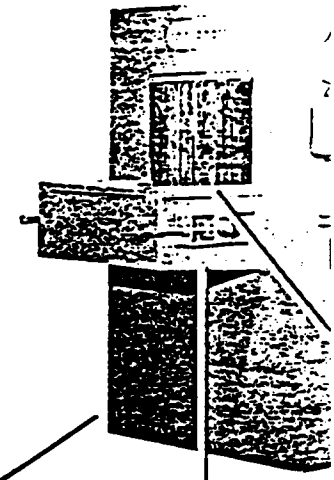
☐ *Efficient Solution Tank Design*
All solution tanks are designed with integral grillage supports which eliminate bottom side condensation and subsequent tank corrosion. Tanks are properly baffled to promote good solution recirculation and to prevent heat-zone and stagnant areas. Heavy duty construction materials assure increased machine life.



☐ *Heavy Duty Housing Access Doors*
Offer easy interior access to spray pipes, nozzles, and blow-off pipes. Hinged construction with quick release cam type latches. Full 24" × 24" opening. Durable, vulcanized door gaskets to eliminate door leaks.

☐ *Painting*
You choose the color. We provide a primer coat to all exterior surfaces and a finish coat of electrostatically applied machine enamel.

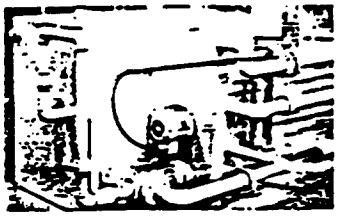
☐ *Internal Exhaust Sys*
Upper housings are provi... with integrally mounted fa... roof type plenums. Easily adjustable dampers are des... to maintain negative stage pressures to eliminate steam vapor leaks and to prevent mature corrosion of the ho... interior. This is accomplish... internally without the need unsightly external ducts.



☐ *Variable Speed D.C. Conveyor Drive*
Externally adjustable potentiometer allows you t... quickly program in the exa... processing speed for every cleaning application.

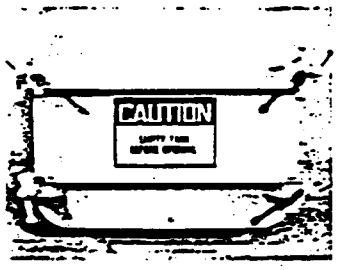
Optional Features

Pro-Clean™ Options: Flexible features tailored to meet the needs of your specific parts washing requirements.



☐ *Oil Decant System*
Significantly increases the life of your cleaning solution while decreasing your chemical and maintenance costs. Assures optimum part cleaning results. This state-of-the-art system removes all non-soluble oils from aqueous washer solutions. The result is significant cost savings in the operation of your parts washer. See Ransohoff Oil Decant product sheet for additional details.

☐ *Additional Solution Stages*
Modular construction allows you to design your own parts cleaning process. Offers great flexibility for applications which require rinsing, rust protection or further chemical treating.



☐ *Marine Type Tank Door*
No bolts, opens easily without hand tools. The bottom of the door is flush with the tank bottom which greatly enhances accessibility for interior machine cleaning and maintenance. These tank doors include heavy duty hinges and full plate gaskets vulcanized to the door.

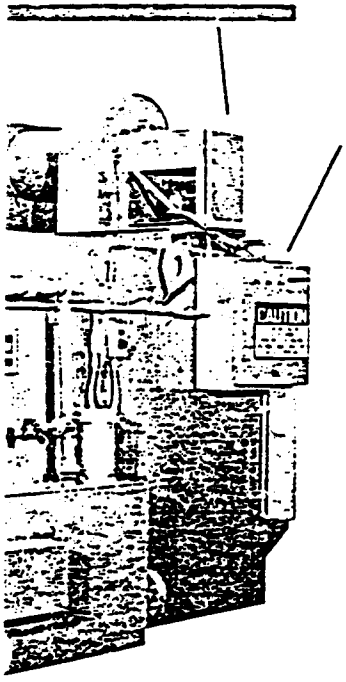
☐ *Chip Baskets*
Easily removable baskets a... designed and located to catc... spent solution for straining to returning to the tank reser...

☐ *Energy Conservation Shutdown Circuit*
Automatically shuts down ... solution pumps and blow-of... when no parts are presente... the machine prior to the pr... purge period. Will then automatically re-start when ... are again loaded into the machine.

☐ *Exhaust Fan*
Tube-axial fan designed to prevent steam or vapors fr... escaping into the plant. As an internal negative pressur... maintains moisture free air ... dry-off compartment.

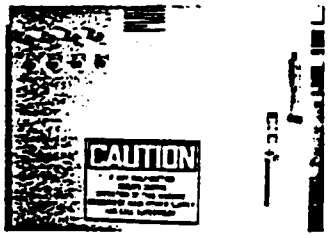
ull Guarding

chain belt drives, all moving
n points are properly guarded
painted for operational
ty. Meets all OSHA
ifications.



leavy Duty Conveyor Belt

ommodates both light and
vy weight applications. Up
ree times stronger than most
r washer belts. Capable of
dling up to 1000 lbs. per foot
elt width.



☐ Electrical Controls

- Panel features individual pushbuttons and light indicators for easy operational and test control of each processing function.
- All control components are Allen Bradley manufacture designed for heavy duty industrial applications.
- First class wiring practices which follow the National Electrical Code.
- NEMA-12 enclosure. Flange operated disconnect. 460 volt operation with 120 volt control transformer.
- Duct type machine wireway offers great convenience in the event future machine control modifications are required.

☐ Machine Run Off

Ransohoff welcomes you to witness a fully operational equipment run-off of your machine, at our plant, before you accept shipment. We run your parts through your machine with your contamination problems and verify the results with state-of-the-art test equipment in our lab. Your total satisfaction from design through installation is our number one goal.

hemical Mixing Tank

powdered cleaner
lications. Assures that
ning compound is quickly
fully dissolved into the
tion bath.

rogrammable Controller

ws interface to existing or
ned computerized
itoring stations. Offers
venient control change and
ess modification capability.
Modicon and Allen Bradley
rollers are available.

olution Filter

ne bag type filter is designed
ll flow filtration with easily
vable elements. Pressure
ges and filter by-pass piping
included.

☐ Machine Insulation

Promotes energy savings and keeps machine surface temperature down as a safety factor. Formed panel construction prevents moisture contamination of the insulation material and provides a first class machine appearance.

☐ Manifold Utility Connections

Single point connection for valved drains allows easy, low-cost equipment installation at your plant.

☐ Right or Left Hand Machine Designs

Offers great flexibility for equipment locating in your existing or future plant layouts.

☐ Solution System Standard Features

- Vertical style pump is easily maintained and non-overloading. Extended motor shaft drive eliminates the potential of seal leakage.
- Fully adjustable solution pressure and flow volume through easily adjustable throttling valves.
- Liquid filled pressure gauges with stainless steel cases and movements. The most dependable gauges available.
- Spray risers are heavy wall pipe and are rigidly supported so spray accuracy is always maintained. Interior spray pipes are easily removable from outside the machine for cleaning.
- All spray nozzles are mounted in threaded couplings which are welded to the spray risers. This assures maximum spray impingement and reduces the potential of riser plugging.

Solution Heating Options

☐ Steam:

- Self operating automatic temperature controller – double seated valve with high capacity load rating; stainless steel trim.
- Three valve temperature control by-pass arrangement allows for emergency manual control of solution temperature.
- Cast iron inverted bucket steam traps for each coil.
- Double embossed immersible plate-coils of heavy gauge steel construction.
- Manifolded piping connections.
- Manually operated main steam-line shut-off valve.

☐ Gas:

- High efficiency pressure burner.
- Heavy wall immersed serpentine flues for maximum tube life.
- Automatic spark ignition.
- Flame safety monitoring.
- High and low gas pressure safety switches.
- Blower proven air flow switch.
- Thermostat control.
- Adjustable gas regulators.
- Automatic on/off safety valve.
- Indicating thermometer.
- Meets Factory Mutual Insurance requirements.

☐ Electric:

- Immersible through-the-wall style heaters with incoloy sheath material and heavy duty mounting flanges.
- Electric thermostat for automatic temperature control.
- Individually fused power circuits to N.E.C. specifications.
- Solution low level protection cut-out switch.
- Panel mounted contactors.

Blow-Off Heating Options

☐ Steam:

- In-line steam throttling valve for manual control of air temperature.
- Cast iron inverted bucket steam traps for each coil.
- Aluminum finned double row radiator coils with copper steam tubes.
- Manifolded piping connections.
- Manually operated main steam line shut-off valve.

☐ Gas:

- High efficiency atmospheric burner.
- Enclosed combustion chamber.
- Automatic spark ignition.
- Flame safety monitoring.
- High and low gas pressure safety switches.
- Blower proven air flow switch.
- Thermostat control.
- Adjustable gas regulators.
- Automatic on/off safety valve.
- Indicating thermometer.
- Meets Factory Mutual Insurance requirements.

☐ Electric:

- Aluminum finned duct type air heaters.
- Electric thermostat for automatic temperature control.
- Temperature high-limit cutout switch.
- Individually fused power circuits to N.E.C. specifications.
- Panel mounted contactors.

PROCLEAN™ by RANSOHOFF

Machine Specifications

Conveyor Series:	24" Conveyor	36" Conveyor
Production	Variable in accordance with belt speed	Variable in accordance with belt speed
O.A. Dimensions	13' L × 8' W × 8'9" H	13' L × 9' W × 9'9" H
Add'l. Stage Dimensions	Add 5'0" to length	Add 5'0" to length
Wash Pump Capacity	100 GPM @ 70' HD	125 GPM @ 70' HD
Rinse Pump Capacity	70 GPM @ 50' HD	80 GPM @ 50' HD
Blow-Off Fan Capacity	3000 CFM @ 7" SP	4500 CFM @ 7" SP
Stage Sequence-Length:	1'6" load. 1'6" vest. 2'6" wash 1'6" drain. 3'6" BO. 1'0" vest. 1'6" unload	1'6" load. 1'6" vest. 2'6" wash 1'6" drain. 3'6" BO. 1'0" vest. 1'6" unload
Addl. Stage	2' rinse. 3' drain	2' rinse. 3' drain
Transfer Type	1 × 1 mesh. galv. flatwire Design Speed @ 2 FPM	1 × 1 mesh. galv. flatwire Design Speed @ 2 FPM
Conveyor Speed	Design Speed @ 2 FPM ½ FPM to 5 FPM	Design Speed @ 2 FPM ½ FPM to 5 FPM
Tank Construction	#7 GA. H.R.S.	#7 GA. H.R.S.
Housing Construction	#10 GA. H.R.S.	#10 GA. H.R.S.
Exhauster Capacity	1500 CFM @ ¼" SP	2600 CFM @ ¼" SP
Tank Capacity-Wsh/Rns	300 Gal./210 Gal.	375 Gal./240 Gal.
Tunnel Size	18" high × 24" wide	18" high × 36" wide

NOTE: All specifications are subject to change without notice.

Contact Ransohoff today for additional details or let one of our experienced sales engineers help you analyze your requirements. We look forward to serving all of your parts washing and surface treating needs.

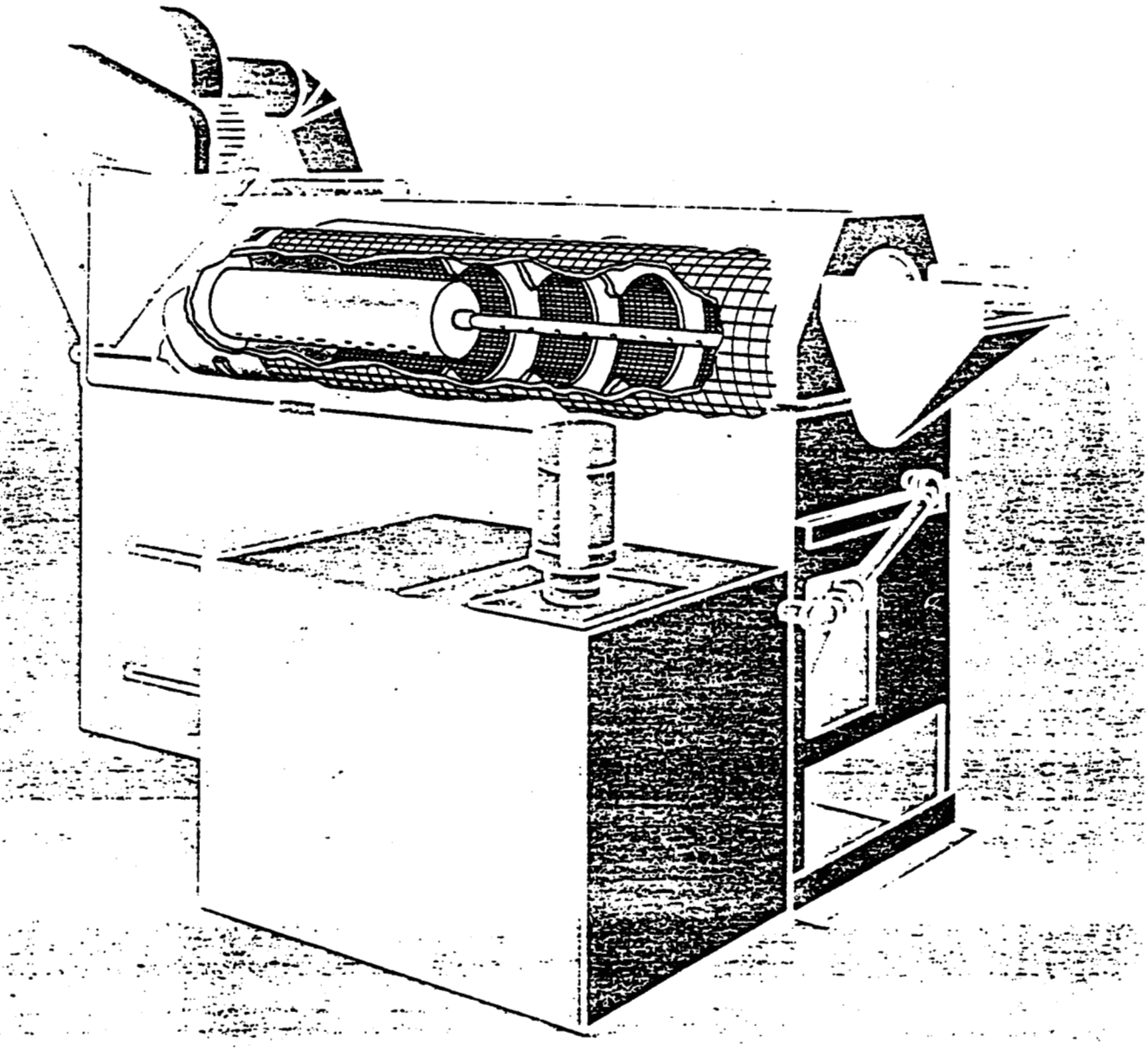
ransohoff

Ransohoff Corporation
North Fifth St. at Ford Blvd.
Hamilton, Ohio 45011
(513) 863-5813
(800) 248-WASH

Over 70 Years of Excellence in Innovating Parts Cleaning and Surface Treatment Solutions

PROCLEAN™
by RANSOHOFF

Drum Series

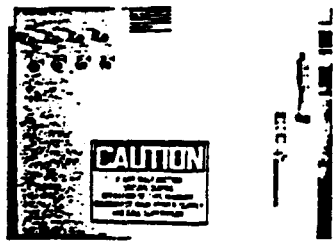


Drum Series

Parts Washers That Offer You Choices. You get the economy of pre-engineering and the flexibility of adding innovative Ransohoff features.

- You choose the features that match your parts washing requirements.
- Replace chlorinated solvent methods of cleaning. Eliminate the environmental and personnel hazards associated with solvent degreasing systems.
- Ransohoff engineering, sales and service staff personally insures the successful installation and ongoing support of your machine.

Here are 13 standard features that should meet all of your parts cleaning equipment requirements:

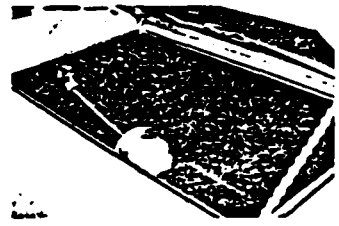


□ Electrical Controls
- Panel features individual pushbuttons and light indicators for easy operational and test control of each processing function.
- All control components are Allen Bradley manufacture designed for heavy duty industrial applications.
- First class wiring practices which follow National Electrical Code.
- NEMA-12 enclosure. Flange operated disconnect. 460 volt operation with 120 volt control transformer.
- Duct type machine wireway offers great convenience in the event future machine control modifications are required.

□ Drum Construction
All Ransohoff drums are constructed to provide years of continuous operation. The internal helix is welded solid for maximum life and to eliminate the potential of part hang-ups.

□ Variable Speed D.C. Drive
Externally adjustable potentiometer allows you to quickly program in the exact processing speed for every cleaning application.

□ Housing Access Doors
Easily removable inspection doors are provided for each stage. Allows convenient drum and interior machine access.

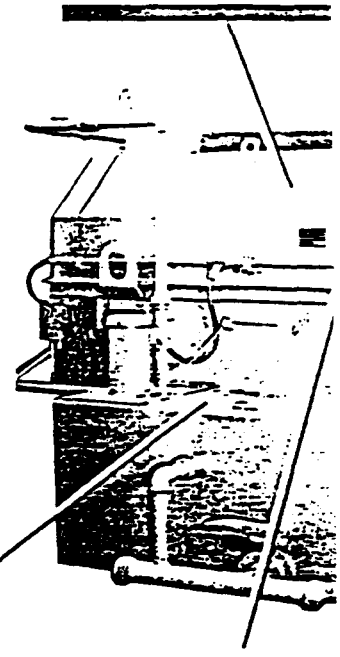


□ Automatic Tank Level Control
Maintains proper solution level, automatically adds make-up for evaporated liquid, eliminates pump cavitation, assures adequate spray on parts.

□ Efficient Solution Tank Design
All solution tanks are designed with integral supports which eliminate bottom side condensation and subsequent tank corrosion. Tanks are properly baffled to promote good solution recirculation and to prevent heat-zone and stagnant areas. Heavy duty construction materials assure increased machine life.

□ Tank Clean-Out Lids
Stainless steel channel type vapor seals are designed to prevent steam from escaping into the surrounding area. Stainless steel hinges and cover lids are provided to enhance equipment longevity.

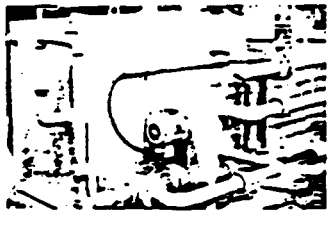
□ Internal Exhaust Syst
Upper housings are provid with integrally mounted fa roof type plenums. Easily adjustable dampers are des to maintain negative stage pressures to eliminate steam vapor leaks and to prevent mature corrosion of the ho interior. This is accomplish internally without the need unsightly external ducts.



□ Removable Upper Housing
Easily removable bolt on construction – facilitates dru removal for replacement or repair.

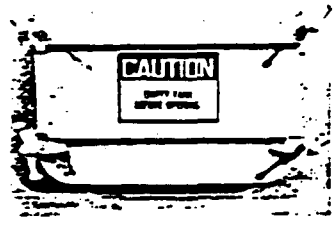
Optional Features

Pro-Clean™ Options: Flexible features tailored to meet the needs of your specific parts washing requirements.



□ Oil Decant System
Significantly increases the life of your cleaning solution while decreasing your chemical and maintenance costs. Assures optimum part cleaning results. This state-of-the-art system removes all non-soluble oils from aqueous washer solutions. The result is significant cost savings in the operation of your parts washer. See Ransohoff Oil Decant product sheet for additional details.

□ Additional Solution Stages
Allows you to design your own parts cleaning process. Offers great flexibility for applications which require rinsing, rust protection or further chemical treating.



□ Marine Type Tank Door
No bolts, opens easily without hand tools. The bottom of the door is flush with the tank bottom which greatly enhances accessibility for interior machine cleaning and maintenance. These tank doors include heavy duty hinges and full plate gaskets.

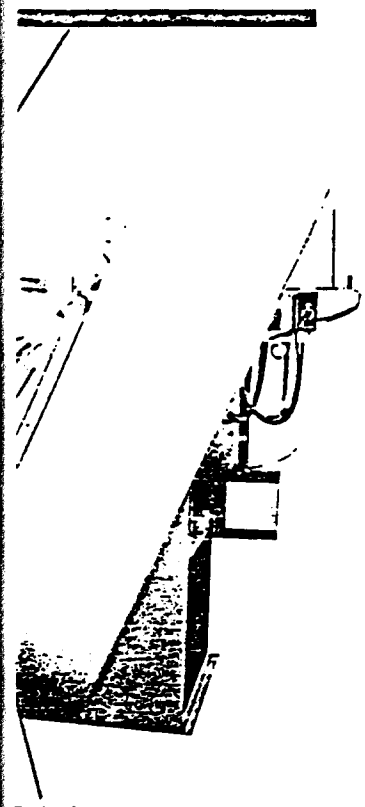
□ Chip Baskets
Easily removable baskets are designed and located to catch spent solution for straining p to returning to the tank reser

□ Chemical Mixing Tank
For powdered cleaner applications. Assures that cleaning compound is quickl and fully dissolved into the solution bath.

□ Programmable Contro
Allows interface to existing planned computerized monitoring stations. Offers convenient control change ar process modification capabil Both Modicon and Allen Brac controllers are available.

...your first choice for

Full Guarding
...chain belt drives, all moving ...ch points are properly guarded ...painted for operational ...ety. Meets all OSHA ...ecifications.



Painting
...choose the color. We provide ...rimer coat to all exterior ...faces and a finish coat of ...ctrostatically applied machine ...mel.

□ Running-Tracks and Support-Rollers
The key to overall operational performance and equipment longevity in every drum washer is the rotating mechanism. Ransohoff drum machines use heavy steel running-tracks, machined after rolling and welding to assure true running and are then welded to the drum shell. The running-tracks roll on heavy duty hardened steel support-rollers which turn free on stub-shafts equipped with heavy duty bearings. The entire trunnion assembly is easily adjustable for alignment and wear.

□ Machine Run Off
Ransohoff welcomes you to witness a fully operational equipment run-off of your machine, at our plant, before you accept shipment. We run your parts through your machine with your contamination problems and verify the results with state-of-the-art test equipment in our lab. Your total satisfaction from design through installation is our number one goal.

Solution Filter
...line bag type filter is designed ...full flow filtration with easily ...novable elements. Pressure ...ges and filter by-pass piping ...included.

Exhaust Fan
...e-axial fan designed to ...vent steam or vapors from ...aping into the plant. Assures ...internal negative pressure and ...intains moisture free air in the ...-off compartment.

Machine Insulation
...notes energy savings and ...s machine surface ...perature down as a safety ...or. Formed panel ...struction prevents moisture ...tamination of the insulation ...erial and provides a first class ...chine appearance.

□ Manifold Utility Connections
Single point connection for valved drains. Allows easy, low-cost equipment installation at your plant.

□ Right or Left Hand Machine Designs
Offers great flexibility for equipment locating in your existing or future plant layouts.

□ Solution System Standard Features
- Vertical style pump is easily maintained and non-overloading. Extended motor shaft drive eliminates the potential of seal leakage.
- Fully adjustable solution pressure and flow volume through easily adjustable throttling valves.
- Liquid filled pressure gauges with stainless steel cases and movements. The most dependable gauges available.
- Spray risers are heavy wall pipe and are rigidly supported so spray accuracy is always maintained.
- Special Ransohoff birdseye spray nozzles prevent nozzle plugging and provide a full cone spray pattern for maximum cleaning efficiency.

Solution Heating Options

□ Steam:
- Self operating automatic temperature controller – double seated valve with high capacity load rating: stainless steel trim.
- Three valve temperature control by-pass arrangement allows for emergency manual control of solution temperature.
- Cast iron inverted bucket steam traps for each coil.
- Double embossed immersible plate-coils of heavy gauge steel construction.
- Manifolded piping connections.
- Manually operated main steam-line shut-off valve.

□ Gas:
- High efficiency pressure burner.
- Heavy wall immersed serpentine flues for maximum tube life.
- Automatic spark ignition.
- Flame safety monitoring.
- High and low gas pressure safety switches.
- Blower proven air flow switch.
- Thermostat control.
- Adjustable gas regulators.
- Automatic on/off safety valve.
- Indicating thermometer.
- Meets Factory Mutual Insurance requirements.

□ Electric:
- Immersible through-the-wall style heaters with incoloy sheath material and heavy duty mounting flanges.
- Electric thermostat for automatic temperature control.
- Individually fused power circuits to N.E.C. specifications.
- Solution low level protection cut-out switch.
- Panel mounted contactors.

Blow-Off Heating Options

□ Steam:
- In-line steam throttling valve for manual control of air temperature.
- Cast iron inverted bucket steam traps for each coil.
- Aluminum finned double row radiator coils with copper steam tubes.
- Manifolded piping connections.
- Manually operated main steam line shut-off valve.

□ Gas:
- High efficiency atmospheric burner.
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□ Electric:
- Aluminum finned duct type air heaters.
- Electric thermostat for automatic temperature control.
- Temperature high-limit cutout switch.
- Individually fused power circuits to N.E.C. specifications.
- Panel mounted contactors.

PROCLEAN™ by RANSOHOFF

Machine Specifications

Drum Series:	18" Diameter Drum	30" Diameter Drum	42" Diameter Drum
Production	12 cu.ft./Hr @ 2 RPM	31 cu.ft./Hr @ 2 RPM	63 cu.ft./Hr @ 2 RPM
O.A. Dimensions	9'2" L × 7'0" W × 7'2" H	13' L × 8' W × 8'11" H	15'6" L × 9' W × 10'6"
Add'l. Stage Dimensions	Add 3'0" to length	Add 4'0" to length	Add 5'0" to length
Wash Pump Capacity	50 GPM @ 40' HD	125 GPM @ 40' HD	150 GPM @ 40' HD
Rinse Pump Capacity	50 GPM @ 40' HD	75 GPM @ 40' HD	100 GPM @ 40' HD
Blow-Off Fan Capacity	1000 CFM @ 3" SP	2500 CFM @ 6" SP	3000 CFM @ 6" SP
Stage Sequence-Length:	1'6" soak. 1'6" wash. 3'6" drain and blow-off	2' soak. 2' wash. 5'6" drain and blow-off	3' soak. 3' wash 5'6" drain and blow-off
Add'l. Stage	1'6" rinse. 1'6" drain	2' rinse. 2' drain	2' rinse. 3' drain
Transfer Type	Drum Worm #10 GA. H.R.S. 10 GA. H.R.S.	Drum Worm #7 GA. H.R.S., 10 GA. H.R.S.	Drum Worm ¼ H.R.S., #7 GA. H.R
Drum Speed	Design Speed @ 2 RPM ½ RPM to 5 RPM	Design Speed @ 2 RPM ½ RPM to 5 RPM	Design Speed @ 2 RPM ½ RPM to 5 RPM
Tank Construction	#7 GA. H.R.S.	#7 GA. H.R.S.	#7 GA. H.R.S.
Housing Construction	#10 GA. H.R.S.	#10 GA. H.R.S.	#10 GA. H.R.S.
Exhauster Capacity	500 CFM @ ¼" SP	1000 CFM @ ¼" SP	2200 CFM @ ¼" SP
Tank Capacity-Wsh/Rns	150 Gal./150 Gal.	375 Gal./225 Gal.	450 Gal./300 Gal.

NOTE: All specifications are subject to change without notice.

Contact Ransohoff today for additional details or let one of our experienced sales engineers help you analyze your requirements. We look forward to serving all of your parts cleaning and surface treating needs.

ransohoff

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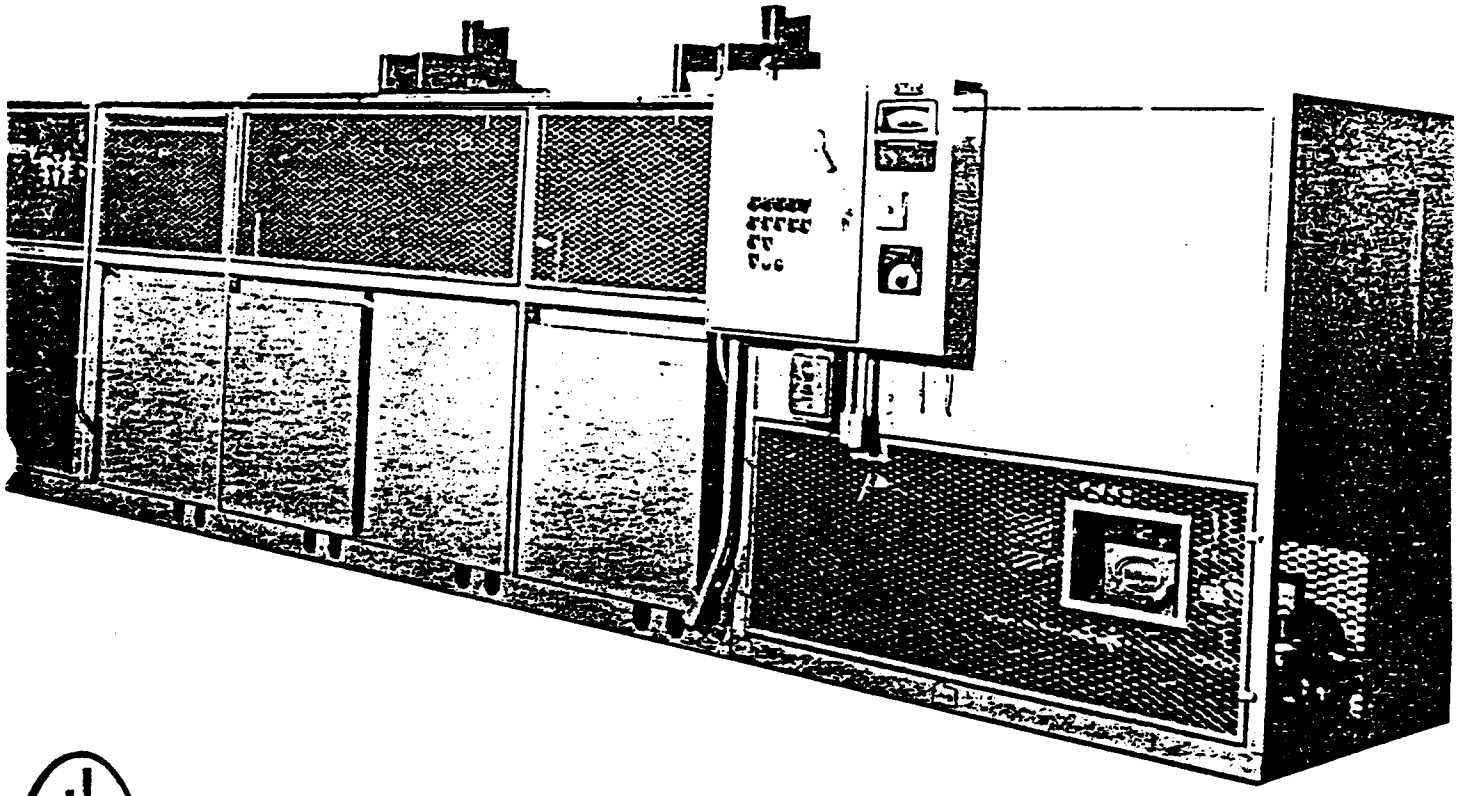
Over 70 Years of Excellence in Innovating Parts Cleaning and Surface Treatment Solutions

METAL PREPARATION OR FINISHING A PROBLEM?



JENFAB

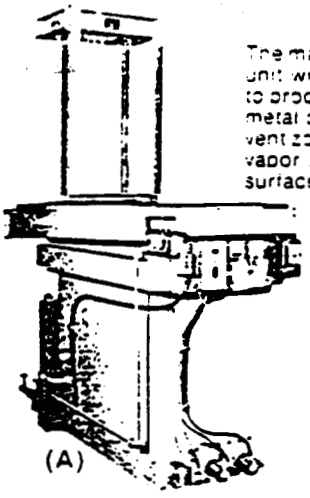
JENSEN

JUST MAY HAVE THE BEST SYSTEM

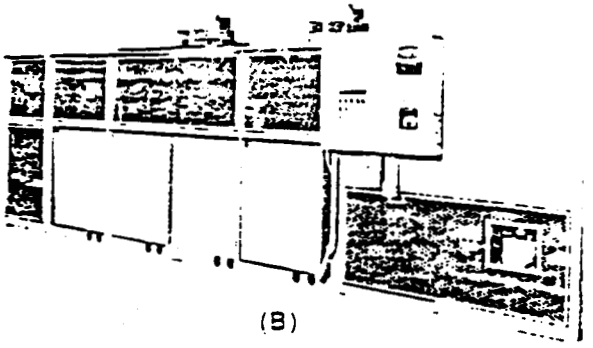
DEGREASER

The marriage of a JENFAB agitating platform unit with a solvent degreaser tank combines to produce this system used in the cleaning of metal parts. Gentle agitation in the liquid solvent zone and nice and easy removal through vapor zone results in a super clean and dry surface.

Jensen does build degreasers with sonics, cross-rod and conveyorized units and plain old open top degreasers — any size.



(A)

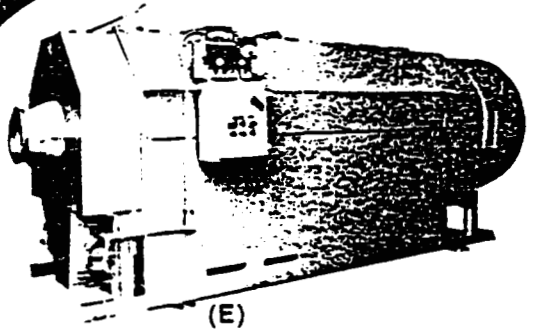


(B)

(B) AGITATING BASKET

Notice the smooth and well guarded lines of this JENFAB agitating four processing system. This machine is equipped with load ng e evator tions for thorough alkaline immersion cleaning, two water rises and station gas heated dryer. Mesh baskets containing fragile parts are agitated in all solutions. Variable timing and variable rate of ag tation ar into controls. Mesh baskets containing fragile parts are gently agitated be *rotated* in all solutions and in drying.

ROTATING DRUM SYSTEMS



(E)

(E) COBMEAL DRYER

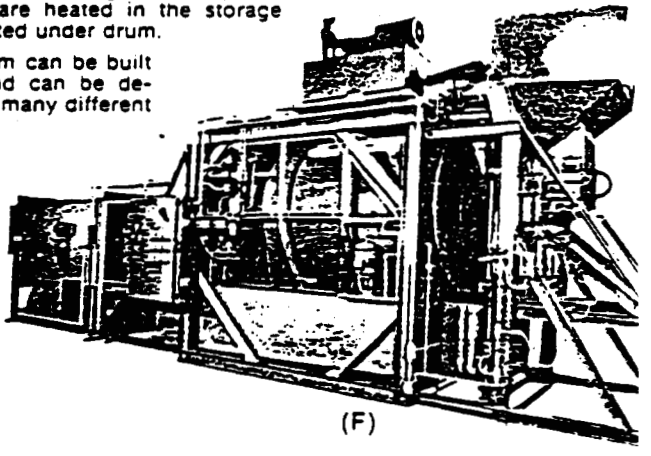
Cobmeal or sawdust is used to thoroughly polish and dry cup shaped or fragile parts in this JENFAB rotary drum system that reheats and reuses the drying media for a SPOT-FREE finish. Batch type or continuous through cycle machines available.

A similar machine can be furnished for drying parts by using re-circulated hot air — gas, steam or electrically heated.

(F) BATCH TYPE ROTARY DRUM

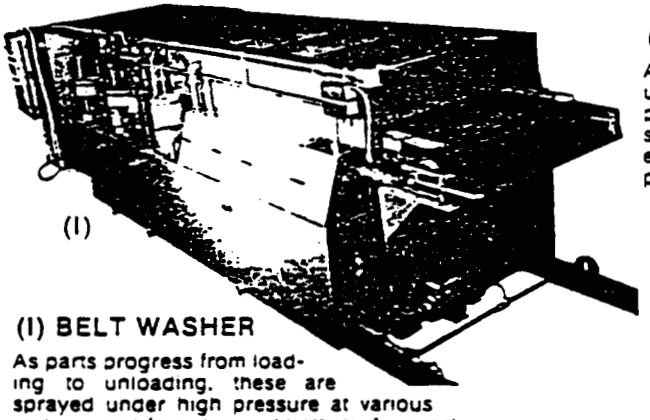
A massive JENFAB rotary drum machine system is shown that is used for load burnishing and cleaning. The six foot diameter rubber lined drum proc a ton of work through a variety of timed and automatic cycles. All c solutions are heated in the storage tanks located under drum.

This system can be built smaller and can be designed for many different processes.



(F)

BELT & CONVEYOR SYSTEMS



(I)

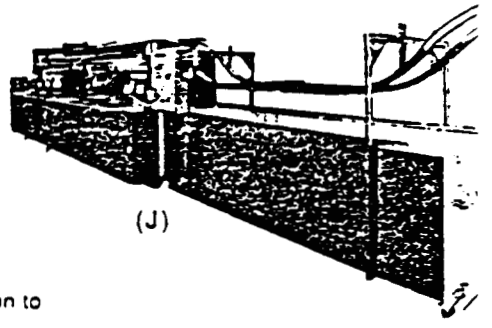
(I) BELT WASHER

As parts progress from loading to unloading, these are sprayed under high pressure at various stations and from top and bottom. An excellent machine for cleaning, rinsing and drying.

This machine can be built as an indexing system with timed movements station to station or it can be run continuously at a controlled speed.

(J) MONORAIL CONVEYOR

A monorail overhead conveyor system such as shown can be used to carry racked parts through various cleaning, rinsing and processing spray sections. In this JENFAB design we combine a soak immersion section before entering a tunnel system equipped with high pressure sprays which further clean and rust proof parts.

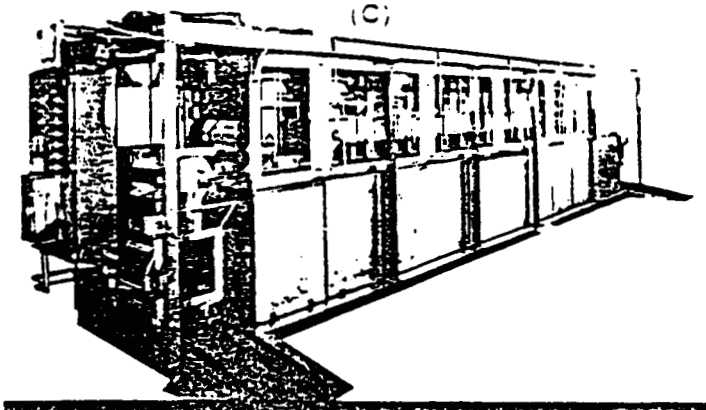


(J)

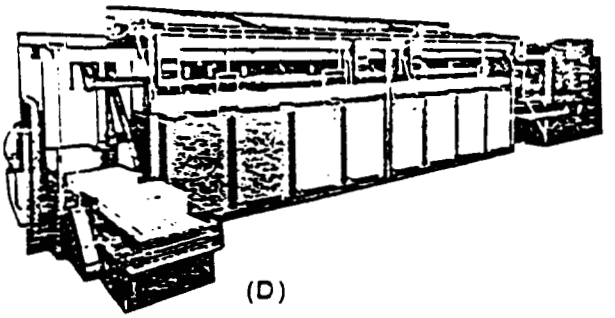
(C) AC

A JENFAB automated barrel processing machine used for very corrosive acid bright plating. Fully enclosed, stainless steel construction and is supplied as a complete modularized system ready for customer connection to plant services.

All operations fully controlled by pre-punched tape — operator has only to load and unload barrels or baskets.



(C)



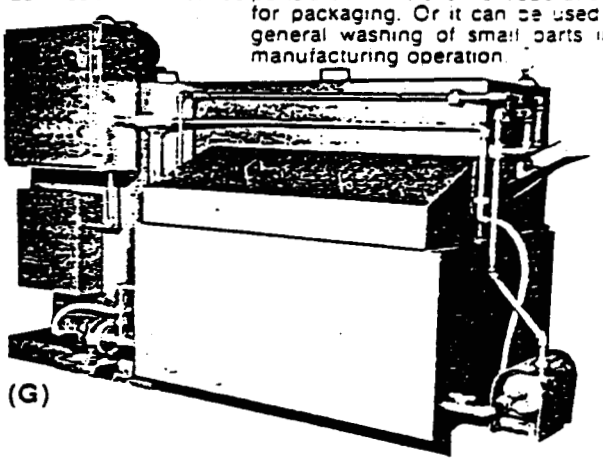
(D)

(D) AGITATING BASKET

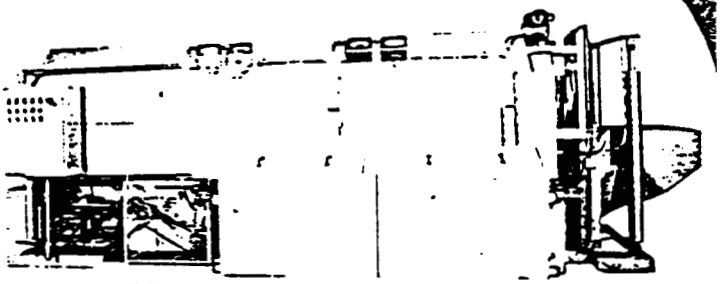
Fully automatic systems that can process baskets, racks or barrels with loads up to 3000 pounds through multiple cycles. Excellent for processing parts that must be handled carefully. Perfect for cleaning, pickling, bright dipping, phosphating or chromating. With or without dryers. A natural for the use of ultra sonic power to aid in cleaning.

(G) IN-LINE WASHER

A small, six foot long, JENFAB rotary drum washing, rinsing and drying system-perfect for installing in line with screw machines, cold headers or stamping presses. Can be fed directly from these machines so that cleaned parts are available for next operation or for packaging. Or it can be used for general washing of small parts in a manufacturing operation.



(G)



(H)

(H) CONTINUOUS ROTARY DRUM

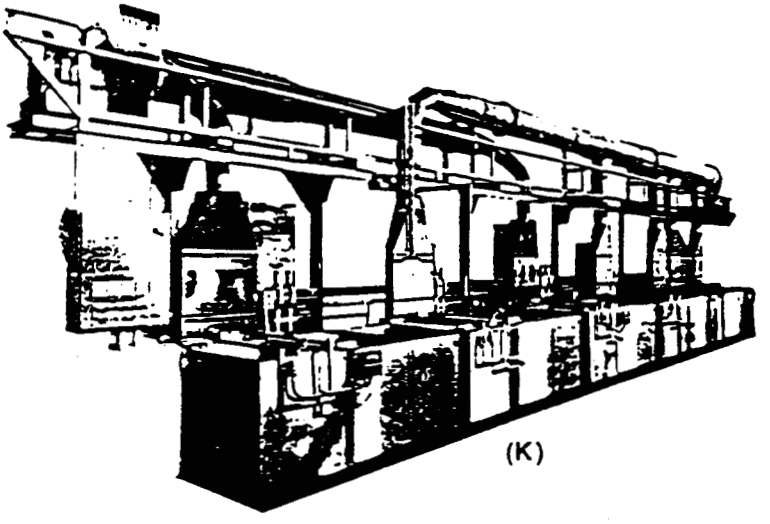
Washing, rinsing and drying of small metal parts is performed in a JENFAB scoop type rotary drum system. A straight through round or eight sided helical drum moves parts gently in flooded work areas with fresh solution being continuously added. Heating by gas, steam or electric.

TANKS

(K) MODULAR UNITS

To save time and money in the installation of equipment, Jensen does ship machine systems pre-wired and pre-piped with only single service connections at customer's plant.

We supply tank lines as a modularized unit. Here we show several processing tanks mounted on a common base and complete with wiring, plumbing, bus work, hoist and ventilation. Shipped in break-away sections and easily installed in a customer's shop.



(K)

JENFAB SYSTEMS

AGITATING MACHINE

sed to process and dry parts in baskets or barrels that quire gentle or vigorous agitation and/or rotation — arts that require special handling.

ROTARY DRUM

orizontal rotating drums can clean, finish and dry naller parts which can only be processed economi- ally in bulk.

CONTINUOUS BELT

Parts that do not require racking or fixturing but still must be handled carefully can be processed in a JEN-FAB continuous belt conveyor system.

MONORAIL CONVEYOR

For parts that are large or that may require racking because excessive handling could cause damage.

MACHINES FOR

CHEMICAL TREATMENT • BRIGHT DIPPING • DEGREASING • PHOSPHATING
ULTRA SONIC CLEANING • CHROMATING • PICKLING • WASHING • DRYING

Almost every cleaning and processing problem is different. The size, the shape, the weight, the soil removal, the final finish are just a few of the many factors that determine just what system would work best.

JENSEN FABRICATING ENGINEERS can offer many years of experience in solving the problems you have — problems we have probably solved before. **TRY US!**

This isn't all that we make or do. We are designers and fabricators of any type of tank used in metal finishing — plating, anodizing, chemical treatments, paint, pickling, bright dipping, storage and in any size or configuration. We install turn-key finishing plants and departments.

DESIGN - ENGINEERING - FABRICATION

WE DO IT ALL

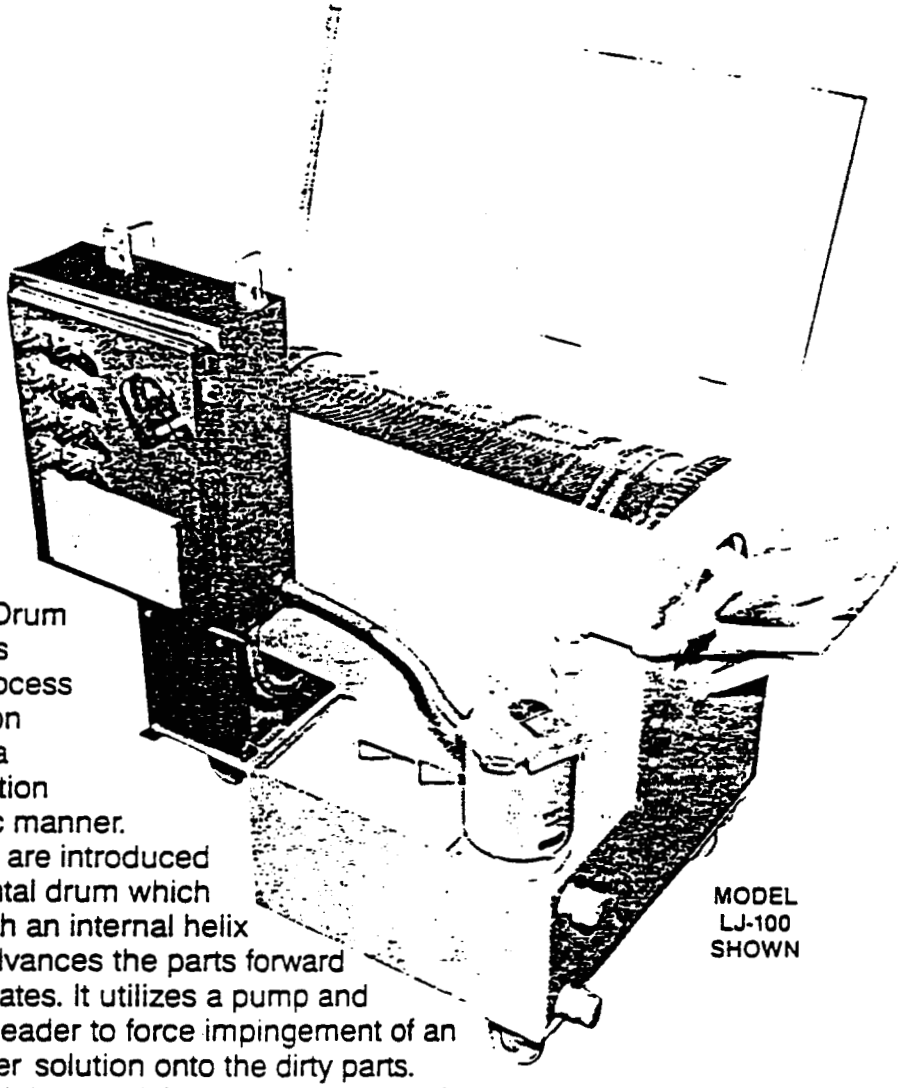
JENSEN FABRICATING ENGINEERS, INC.

PLANT ADDRESS
555 Wethersfield Road, Berlin, CT

MAILING ADDRESS
P.O. Box 307, East Berlin, CT 06023

TELEPHONE
(203) 828-6516

JENFAB LJ-SERIES ROTARY DRUM PARTS WASHER



MODEL LJ-100 SHOWN

The Jenfab LJ-Series Rotary Drum Parts Washer is designed to process small production loads through a cleaning operation in an automatic manner.

Dirty parts are introduced into the horizontal drum which is equipped with an internal helix auger which advances the parts forward as the drum rotates. It utilizes a pump and internal spray header to force impingement of an aqueous cleaner solution onto the dirty parts.

This scaled down unit incorporates many of the successful engineering features found in Jenfab's larger standard washers. It can be used as an **In-Line** system, or in a **Cell** operation. As a **Free-Standing** unit it can be used for cleaning and drying. Additional stations can be added as optional units.

Multiple Uses — In-Line, Cell, Free-Standing

Limited Space Requirement

Designers and Fabricators of Quality Metal Finishing Equipment

STANDARD FEATURES

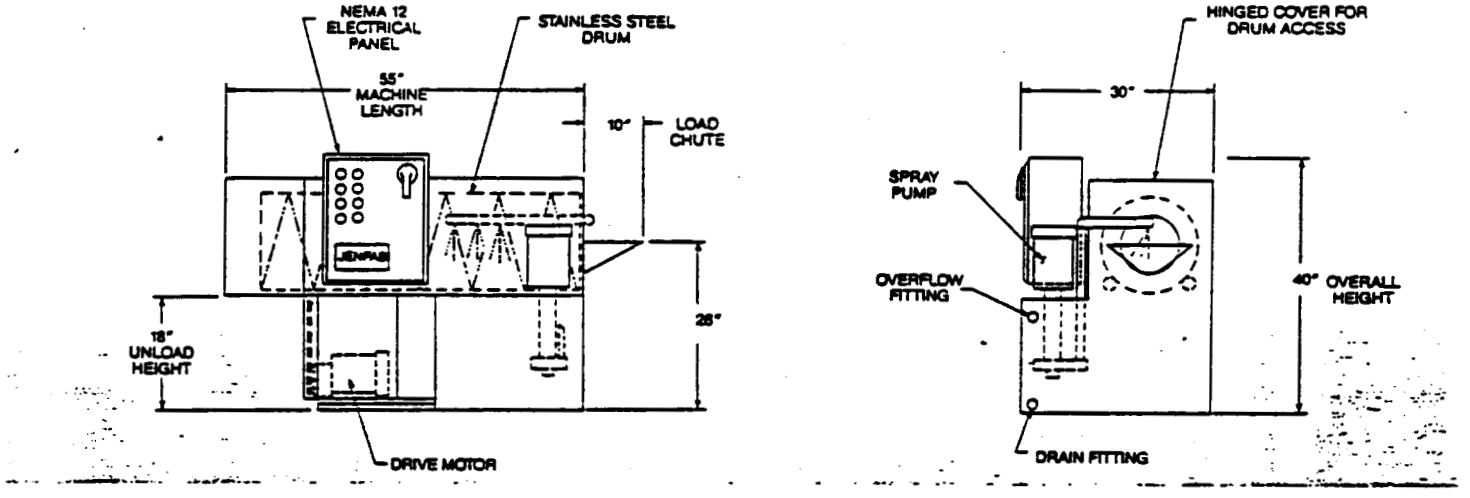
• Heavy gauge welded steel construction • 15" diameter drum, 14 gauge. stainless steel
• Hinged top for drum access • All-iron sealless vertical pump
• Pre-wired and pre-piped • NEMA 12-electrical panel • Mounted support frame
• Heavy duty drum rollers and rotational support rings • 2 rpm fixed drum speed

OPTIONAL FEATURES

• Stainless steel tank construction • Variable speed drive • Heated dryer
• Electric tank heat • Tank insulation • Oil separation • Casters

SPECIFICATIONS

• Tank volume: 40 gallons • Work load capacity: Approximately 400 lbs/hr
• Perfs — 1/8" standard (other sizes available) • Portable



OTHER JENFAB SYSTEMS

AGITATING MACHINE • CONTINUOUS BELT • MONORAIL CONVEYOR
ROTARY DRUM MACHINES • HOT AIR AND COB MEAL DRYERS

MACHINES FOR

CHEMICAL TREATMENT • BRIGHT DIPPING • DEGREASING • PHOSPHATING
ULTRASONIC CLEANING • CHROMATING • PICKLING • WASHING • DRYING

DESIGN • ENGINEERING • FABRICATION

WE DO IT ALL

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TELEPHONE (203) 828-6516 • FAX (203) 828-0473

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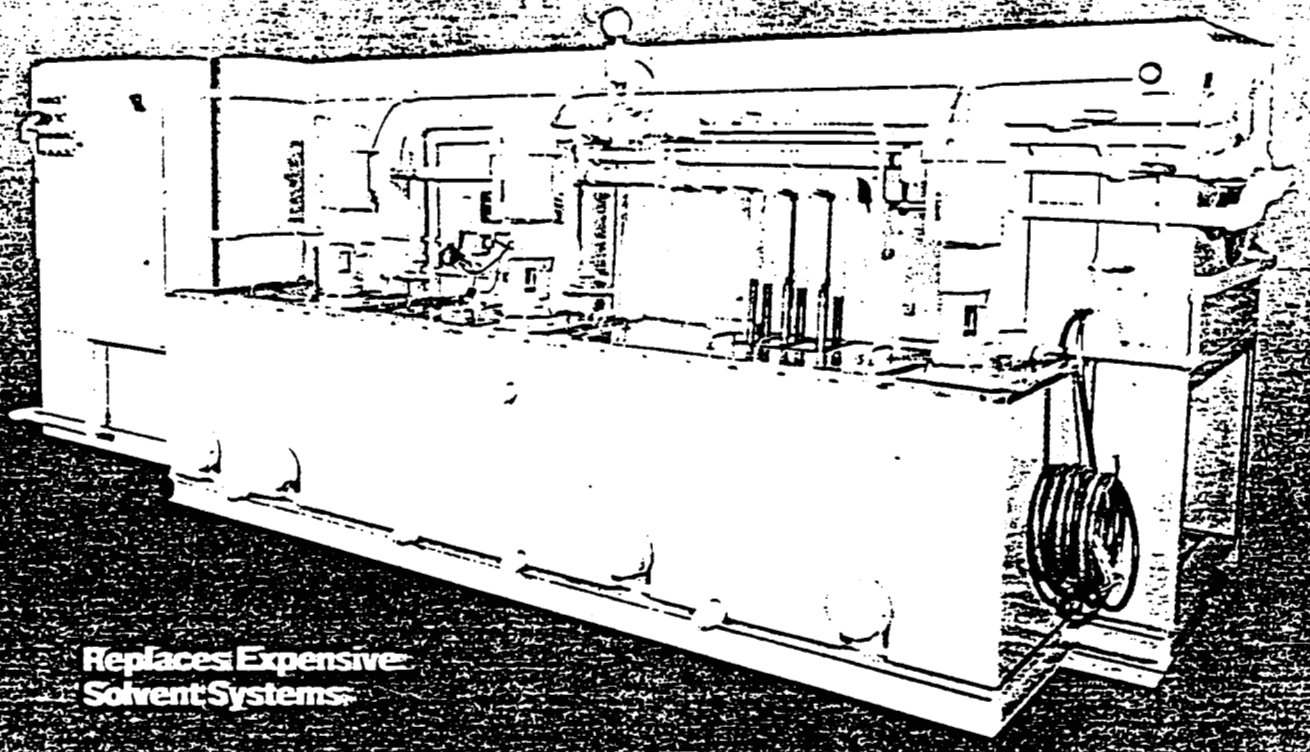
ed in U.S.A. 1-90-5M Form RSLJ-100

STANDARD AND CUSTOM DESIGNED

ROTARY DRUM PARTS WASHERS



Replaces Expensive Solvent Systems

AUTOMATIC OPERATION

Designed for Easily Disposable Water Based Detergents

A versatile design available with multiple process stations for washing, rinsing, rust inhibiting and drying.

Also used for bright dipping, acid stripping, color coatings and phosphating.

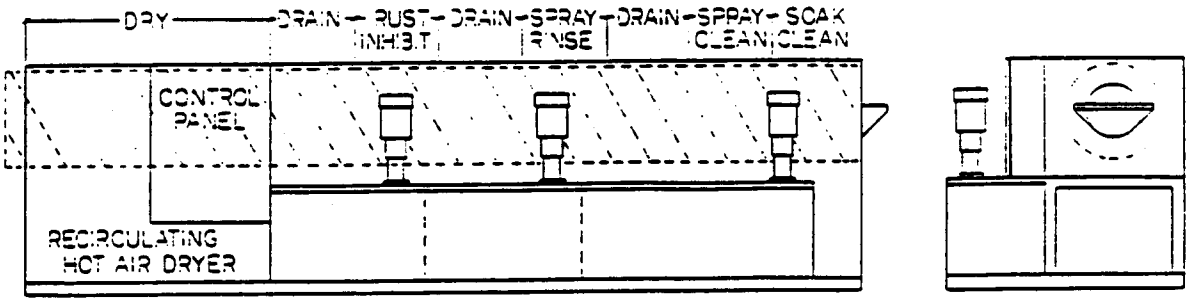
In-house demonstration machines available for testing.

Video tape presentation available upon request.

Ideal for headed parts, stampings, screw machine parts, forgings, fasteners, deep drawn shells, and molded plastic parts.

JENFAB

A Typical Four-Station Rotary Parts Washer



STANDARD FEATURES

Engineered With *Off-the-Shelf* Components for Ease of Maintenance

- Steel or stainless steel construction.
- 24" through 48" diameter drums, custom designed for each customer's parts.
- Energy efficient recirculating hot air dryers.
- "In tank" mounted vertical end suction pumps.
- Single point utility connections for easy installation.
- Heavy duty base frame and superstructure.
- Machined drum rings—heavy duty bearings.

OPTIONAL FEATURES

- *Ultrasonic* cleaning capability available.
- Combinations possible—flat belt and rotary drum.
- Systems used in conjunction with cobmeal dryers.
- Rigidized or embossed drum material.
- Automatic chip and oil removal systems.
- Automatic load and unload features.
- Special "Marine Type" clean out doors.

SATISFIED USERS

Duracell • General Motors • AC Spark Plug • New Departure/Hyatt Bearings • Century Brass • Robbins Mfg. Co. • Union Carbide • Torrington Co. • Textron • TRW—Carr Div., Palnut Div., Bearings Div. • Scovill Mfg. Co. • Parker Hannifin • Morse Automotive Products • Buell Industries • Rexnord

MACHINES FOR Chemical Treatment • Bright Dipping • Degreasing • Phosphating • Ultrasonic Cleaning • Chromating • Pickling • Washing • Drying
Design • Engineering • Fabrication—We Do It All

JENFAB

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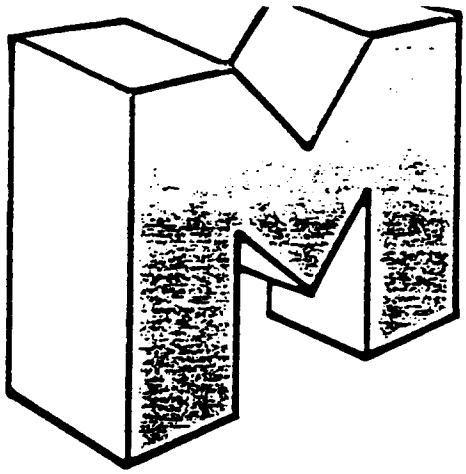


Toll Free:(800) 338-8778
Fax: (815) 338-8711
Phone: (815) 338-8700

J.S. MANNOR MACHINE CORP.

USTRIAL PARTS WASHERS, WATER TREATMENT SYSTEMS, NVEYORS, CENTRIFUGAL SPINNERS, LOADERS, SURFACE EATMENT EQUIPMENT.

We Build Superior Equipment at Competitive Prices

nor Machine has delivered over 2,500 parts washers worldwide with a customer base of 700 es. Better than 70% of our business is repeat business. Once a manufacturer buys one of ines, he will buy again and again. The reasons include our quality, service and technical all at competitive pricing.

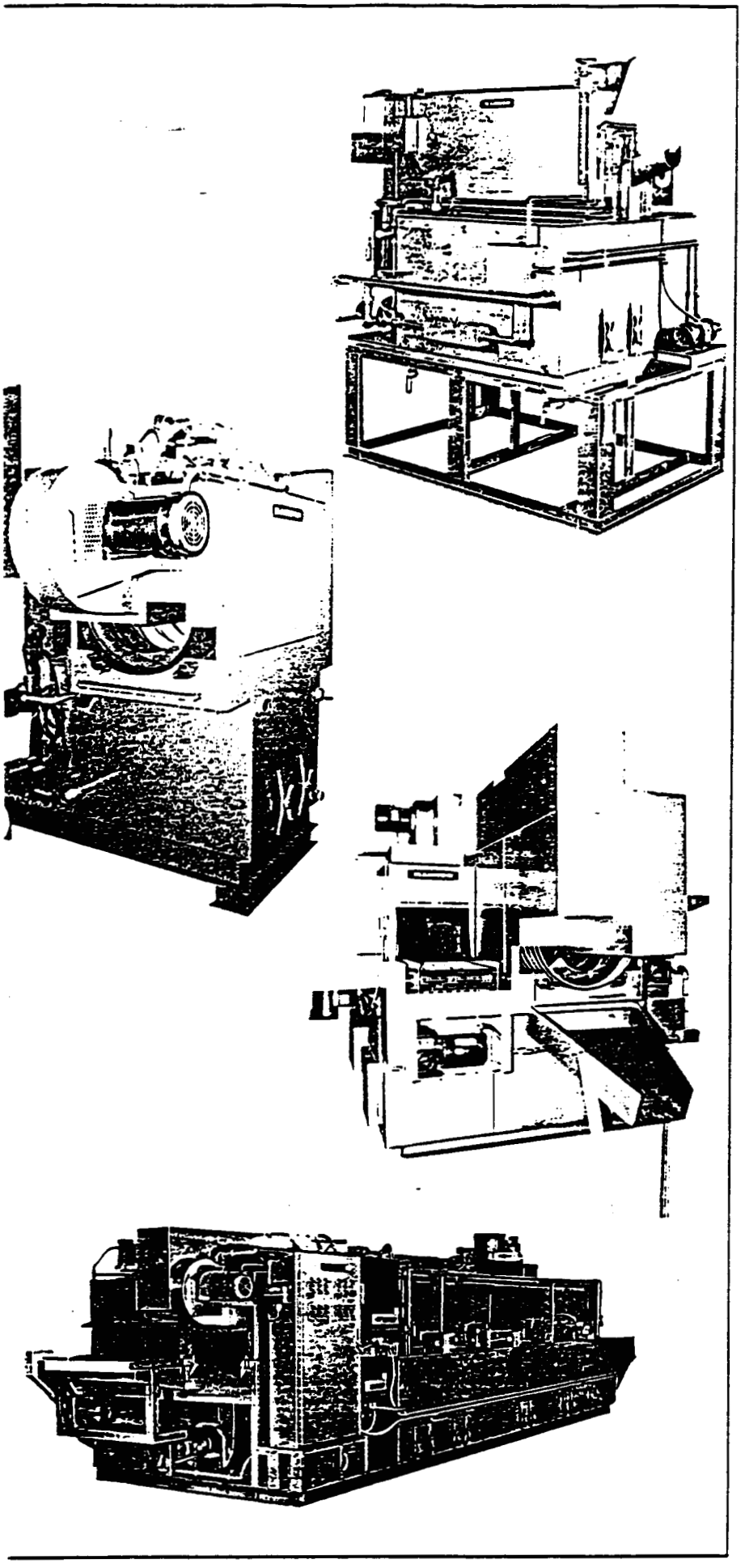
Standard Features

Sloped tank bottom
Tank drains
Safety overflow coupling
/16" tank walls
Stainless Steel sheath
electric immersion heaters
Stainless Steel spray nozzles
Automatic water make-up
40 PSI process spray
Exhaust cowling

Optional Features

Chip Separator
Oil Skimmer
Lower heated blow-off
Tank Insulation
Blower Insulation
Dual Filters
Natural Gas or Steam Heat
Variable Speed Control
NEMA 12 controls
Water Treatment Center

ner will clean the first part processed, but a washer's real value is determined by it's ability to ully clean parts 10 years later. This is where we shine. Our understanding of the water processing) extend the life of the washer bath, as well as the demanding durability the industrial environment has resulted in Mannor developing a family of machines to meet your requirements.



Rotary Drum Washers

J.S. Mannor Machine rotary drum washers offer the best cleaning available. Production parts are completely submerse and sprayed in the first station the washer for optimum cleanir results. An internal helix conve the product to subsequent stations. Special materials are available for stringent material handling. Equipment can accommodate one, two or mor process stations to meet your application.

Combination Units

Our combination units are designed to process dissimilar parts with common soils. A typical example sees a rotary drum on one side cleaning fasteners, while a flatwire belt cleans the material handling pans. Conveyor types include drum, belt, walking beam, vibratory brush and monorail, which can be handled at a minimum cost with our interchangeable cabinetry.

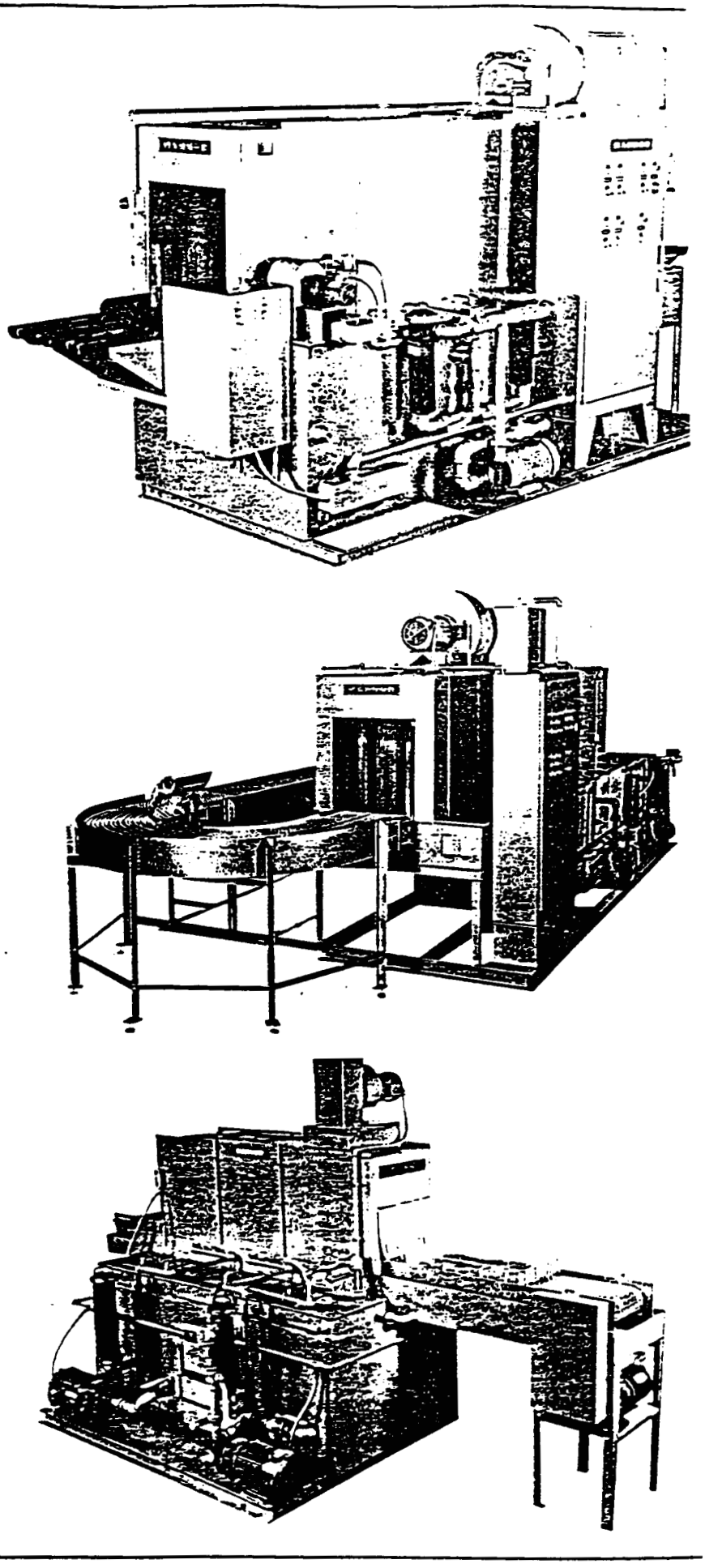
Walking Beam Conveyors

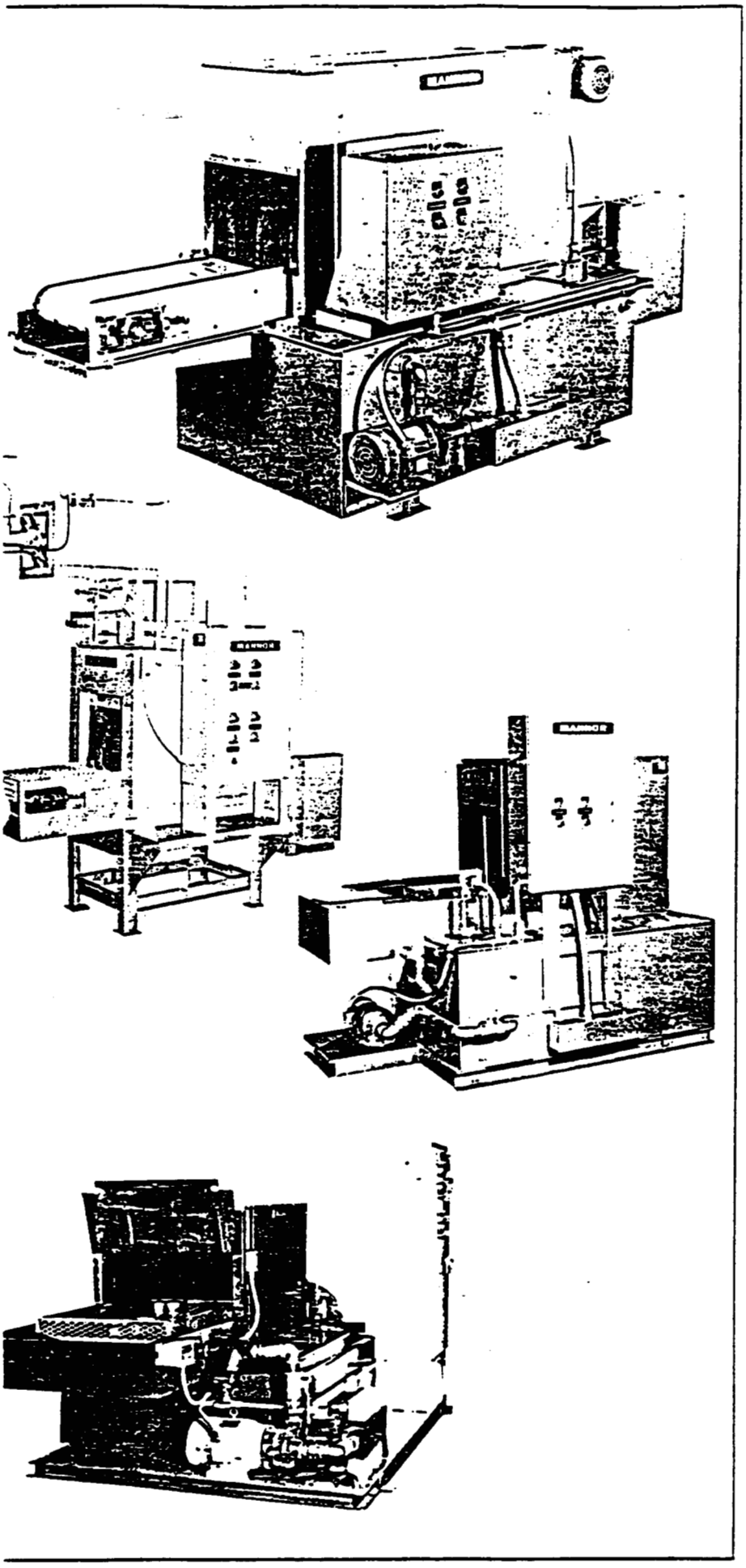
Walking beam conveyors offer a sturdy, durable means of conveying large/heavy product. An additional advantage allows positioning stationary and moving beams to orient an irregular shaped part for processing in tandem with dedicated spray nozzles and flow-offs.

Other advantages include walking beam machines which hold castings at an incline to promote flushing and drainage of internal ports and cavities. Our Auto-Roll™ system will oscillate the part 180° in one or more rotations for excellent cleaning and drying, inside and out.

Versatile Belt Conveyors

Versatile belt conveyors handle product directly on the belt or in baskets. Special conveyor speeds and process times can easily be designed into the machine to match cleaning chemical requirements. Fixtures can be mounted on the belt for part orientation and robotic load/unload.





Inline Washing

Inline washing offers significan cost savings. Cleaning parts seconds after manufacture reduces the required operating temperature, process time, chemical concentration and aggressiveness of the cleaner because the soils have not had chance to "set up" on the parts Also, work-in-process is kept t a minimum.

Compact Cellular Washers

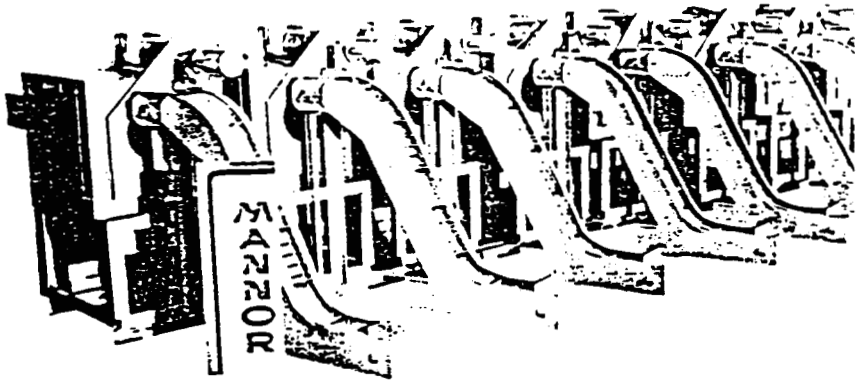
Compact cellular washers offer dedicated, single or multi-stage process cleaning for a manufacturing work cell. The operator can place the product on the conveyor or in a receptacle and have process clean parts for the next operati internal to the work cell cycle time.

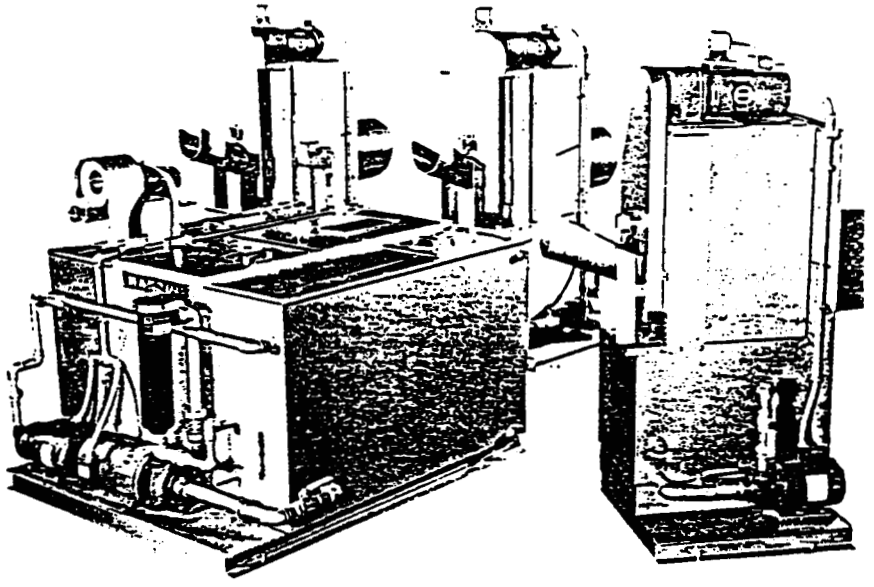
Multiple In-line Washers

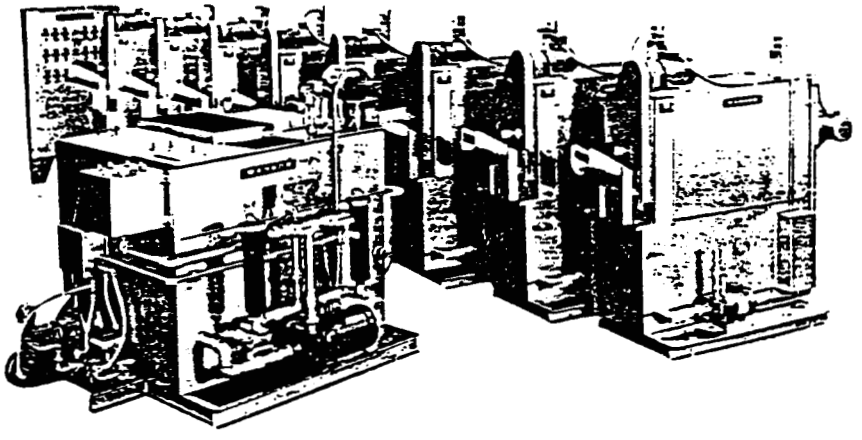
Parallel manufacturing lines such bearing, casting, roller chain fastener production perience common soils at ultiple locations. When nsidering material handling d work-in-process costs, ultiple washers located mediately after the anufacturing step deliver a bstantial cost savings. Inline ashers have proven to reduce anufacturing expenses, but if e soils are being cleaned, why y for an individual pump, filter, lution heating, water make-up, emical make-up and oil moval, as well as maintenance all of these locations?

Water Process Systems

S. Mannor Machine has applied water process tanks m 300 to 4,000 gallons to rform all of these steps at one ation. Our water process nks locate all water/cleaner intenance at one convenient ation which can be sitioned hundreds of feet from e manufacturing line. This ults in a much smaller "remote sher" using less nufacturing floor space while ring all the advantages of a ge wash tank volume and ution life.







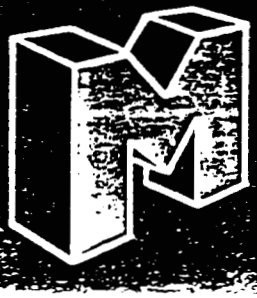
Behind the Scenes

J.S. MANNOR MACHINE CORP.
427 East Judd Street
Woodstock, Illinois 60098
Phone (815) 338-8700

J. S. MANNOR MACHINE CORP.

Sample List of Parts Processed Through Mannor Machine

- Castings
- Stampings
- Brake Cylinders
- Rotary Unions
- Plumbing Fittings
- Bearings
- Heat Treating
- Spray Guns
- Window Frames
- Brake Parts
- Drills
- Taps
- Power Tools
- Screws
- Nuts
- Bolts
- Transmission Castings
- Knife Blades
- Rivets
- Forgings
- Air Cleaners
- 2-4 Cylinder Engines
- Roller Bearings
- Nails
- Valve Covers
- Cold Formed Parts
- Decorative Metal Products
- Hardware
- Hydraulic Fittings
- Automotive Castings
- Locks
- Chains
- Chain Saws
- Carburetors
- Tote Pans
- Electric Components (Tube Cutters, Formers)
- Compressors
- Shock Absorbers
- Bake Trays
- Outboard Engines
- Navigational Equipment
- ATV's
- Gas Cans
- Seals, Rubber
- Turbine Blades
- Rocker Arms
- Push Rods
- Sprockets
- Gears
- Automotive Accessories
- Lifters
- Continuous Strip
- Continuous Band Saw Blades
- Powdered Metals
- Porcelain
- Brass Fittings
- Motorcycle Engines
- Hand Tools
- Exhaust & Intake Manifolds
- Ball Bearings



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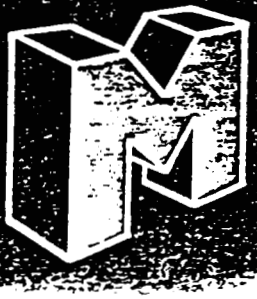
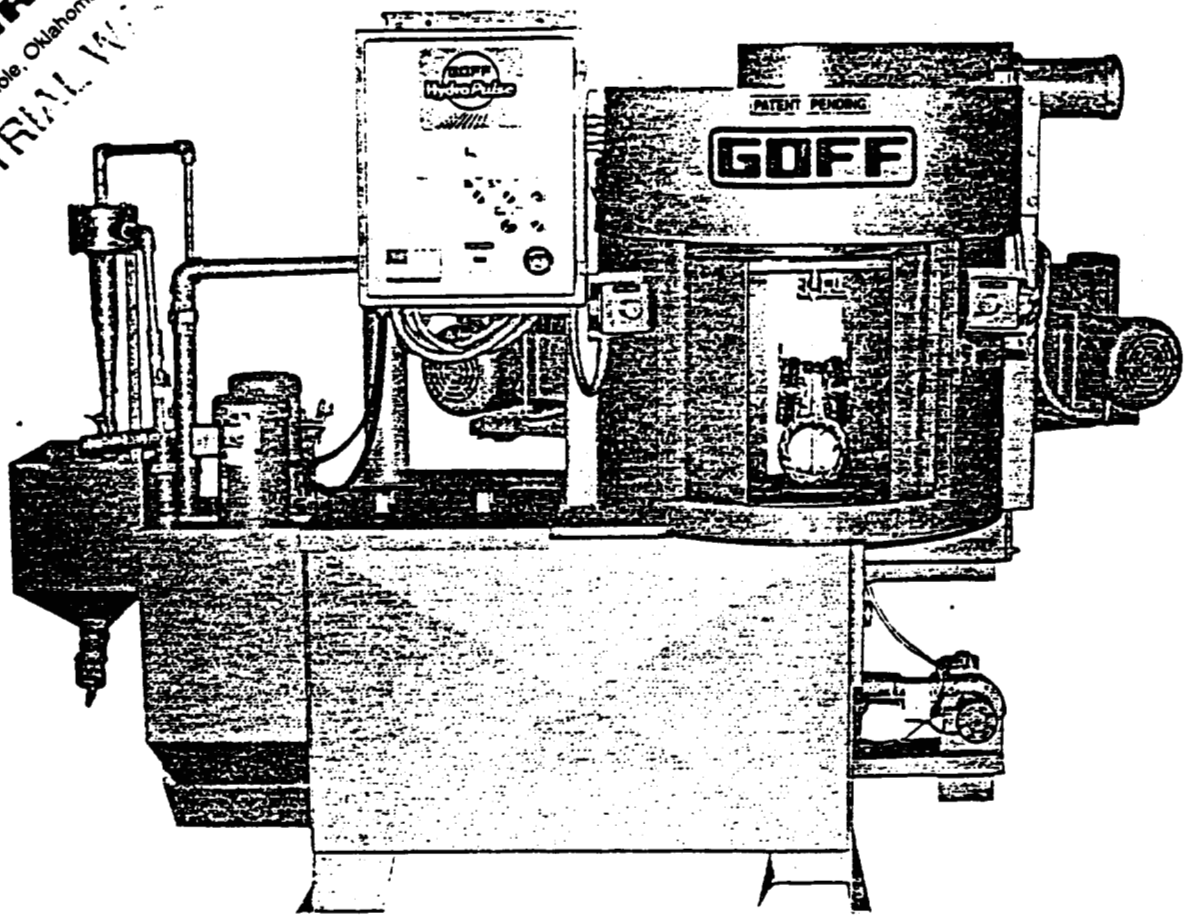


GOFF CORPORATION
P.O. Box 1607 · Seminole, Oklahoma 74868 · Tel 405 382 69[illegible] · FAX 405 [illegible]
INDUSTRIAL [illegible]

[illegible]HER
MODEL 1316
SPINNER HANGER



PATENT PENDING

GOFF HydroPulse

MADE IN U.S.A.

NO DOORS TO OPEN & CLOSE

NO WAITING TO LOAD OR UNLOAD

CONTINUOUS PRODUCTION

GAS FIRED HEATER

SELF CLEANING TANK

TWO 5 HP DIRECT DRIVE WATER WHEELS

DETERGENT OPTIONAL

MACHINE WARRANTY

100 LB HOOK CAPACITY

[illegible] HP PRESSURE PUMPS

[illegible] - MODEL HP 1316 SPINNER HANGER WASHER

WATER BLAST UNIT

WHEEL - Two water wheel units (Standard).
The direct drive blast wheel units rotate at 1750 RPM for maximum water velocity. The 14" diameter blast wheel units are fabricated of stainless steel.
WHEEL HOUSING - Fabricated from 1/4" steel plate and lined.
CONTROL NOZZLE - Cast of wear resistant alloy and adjustable for pattern control.

BLAST CHAMBER CONSTRUCTION

WORK HANDLING - Three chambered drum constructed of stainless steel inner panels, steel top, bottom and outer panels.
DRUM DRIVE - Exterior mounted C-face motor and gear reducer powers a chain and sprocket drive. Torque limiting is provided between drum shaft and final sprocket for jam protection.
HOOK SPINDLE - Continual rotation of hook spindle during blasting operation provides full exposure of parts to the blast stream.
HOOK SPINDLE CAPACITY - 100 lbs. per hook.
HOOK SPINDLE SPEED - 9 RPM.
WORK HANDLING CAPACITY - Maximum area provided for material to be blasted is 13" diameter x 16" long.

CABINET CONSTRUCTION

CABINET - Constructed of 1/4" steel with 12 ga. removable front panels sealed with neoprene for leak and noise control.
PUMPS- Vertical centrifugal sump pump is sealess cast iron construction with direct coupled TEFC motors.

PIPING

PIPING FROM PUMP TO WHEEL - is schedule 40 steel with oil resistant, high temperature rubber hose at wheel connection. Hose allows for ease of maintenance and adjustments.
PIPING TO CYCLONE - is schedule 40 steel to water level and schedule 80 CPVC above water level. CPVC material is wear resistant and helps control heat loss.

CYCLONE SEPARATOR SYSTEM

CYCLONE SYSTEM - is a closed loop design and is operated continuously to remove solids from tank area before they accumulate and generate erosion in the washer. A waste hopper is installed below the cyclone to collect solids. Solids are removed from hopper through a valve and into a waste container for easy disposal.

OIL SKIMMER

A direct driven 1/10 motor turns a 12" dia polyurethane wheel to continually skim oil from top of water.

TANK CONSTRUCTION

TANK - Constructed of 1/4" steel plate formed and welded. No bottom drains insure against accidental spills and improper discharges of tank contents. Tank is insulated with 1" styrofoam sheets and 16 ga. cover panel. Tank capacity is 100 gallons.
HEATER BURNER - A self ignition, safety blower burner system is used for water heating. A pressure switch senses blower on. Gas pressure and pilot light are monitored before main gas valve is opened for burner ignition. Burner is 250K BTU.
FIRE TUBE - A welded and pressure tested tube channels and transfers heat to water within the tank. System is very efficient with minimum heat loss.

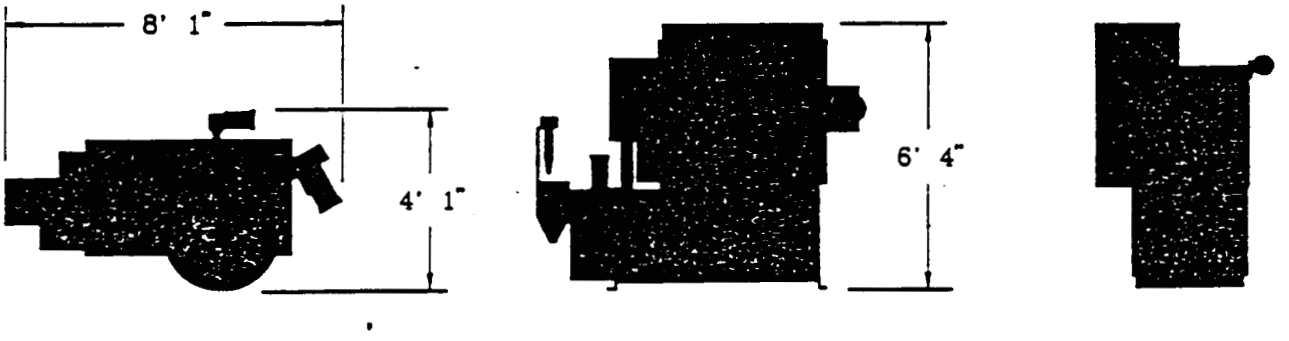
ELECTRIC MOTORS

All motors are T.E.F.C., ball bearing, 230/460 volts, 3 phase

Water Blast Wheel (2)	5HP, 1750 rpm
Chamber drive	1/3 HP, 1200 rpm
Spinner drive	1/3 HP, 1750 rpm
Main pump	3 HP, 3450 rpm
Cyclone Pump	2 HP, 3450 rpm
Oil Skimmer	1/10 HP, 16 rpm

GOFF HydroPulse

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



Floor View | Front View | Side View

[illegible] CORPORATION

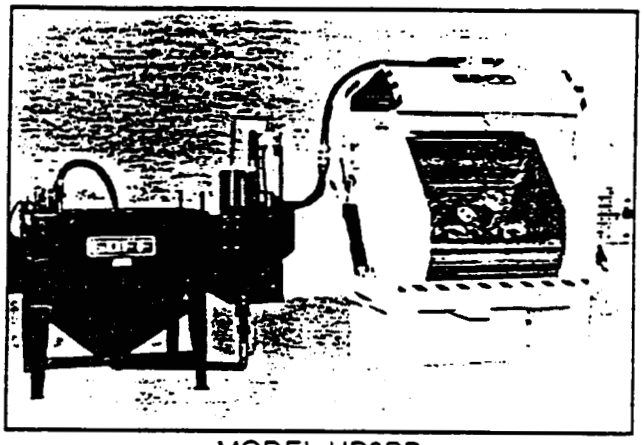
1 Pleasant Grove Rd. · P.O. Box 1607 Seminole, Oklahoma 74868 · Tel. 405/382-6900 · FAX 405/382-701[illegible]

GOFF CORPORATION
P.O. Box 1607 · Seminole, Oklahoma 74868 · Tel 405 382 6900 · FAX 405 382 7013
INDUSTRIAL WASHING EQUIPMENT

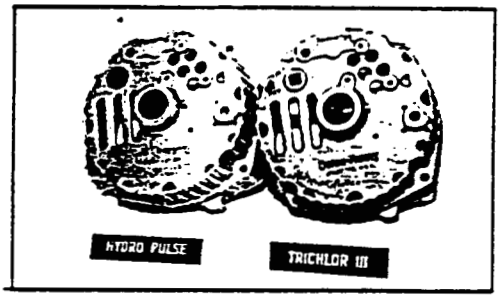
Clean Better with Water . . .

HYDRO PULSE vs TRICHLOR III

Patent Pending

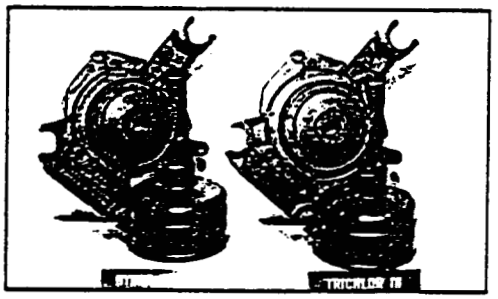


MODEL HP6PB



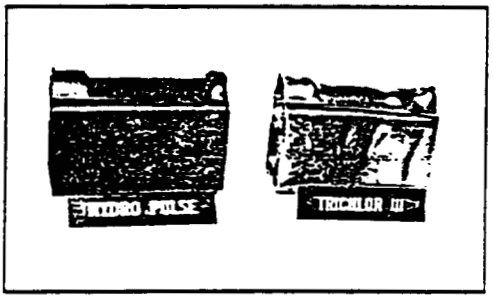
HYDRO PULSE	TRICHLOR III
• 3 min Water	• 15 min Degrease
• 3 min Blast	• 3 min Blast

Savings: 12 min per load
Hydro Pulse Advantage: No chemicals



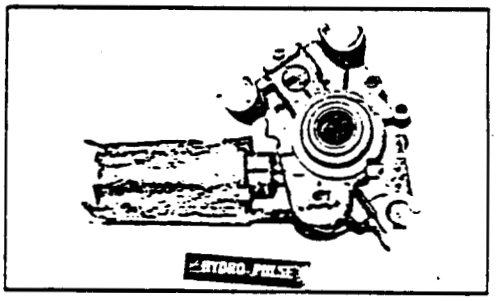
HYDRO PULSE	TRICHLOR III
• 3 min Water	• 15 min Degrease
• Paint	• 15 min Spray wash
	• 3 min Blast
	• Paint

Savings: 30 min per load
2 steps - handling
Hydro Pulse Advantage: No chemicals



HYDRO PULSE	TRICHLOR III
• 3 min Water	• 15 min Degrease
• Paint	• 2 min (each) Hand Buff
• 100 per load	• Paint

Savings: 3 1/2 hours per 100 units
Hydro Pulse Advantage: No chemicals



HYDRO PULSE	TRICHLOR III
• 5 min Water	• 15 min Degrease
• Paint	• Disassemble
• 25 per load	• 3 min Blast
	• Re-assemble
	• Paint

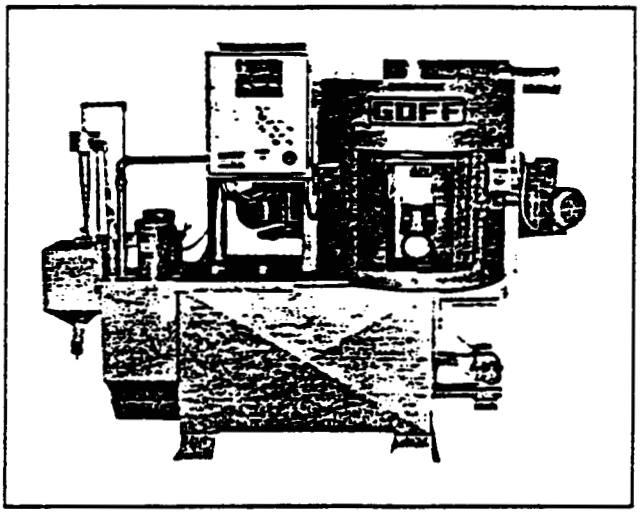
Savings: 1 hour 15 min. per 25 units
Hydro Pulse Advantage: No chemicals

GOFF HydroPulse

HYDRO PULSE vs TRICHLOR

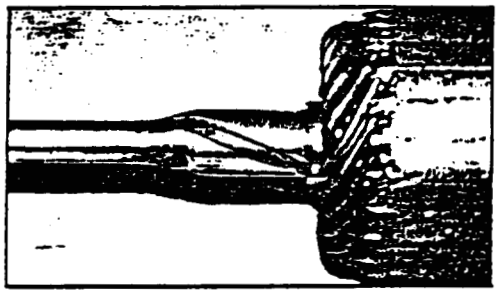
ON ELECTRICAL PARTS

GOFF HydroPulse

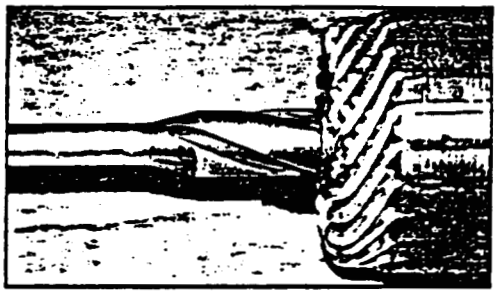


MODEL HP1316 SPINNER HANGER

Patent Pending



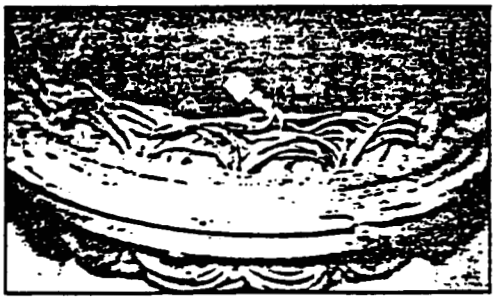
ARMATURE



- 20 min in Trichlor
- Trichlor did not clean between windings
- Dirt in gear area not removed
- Had to be wired brushed

- Run in Goff 1316 Spinner
- 4 per load
- 5 second cycles
- Water only

HYDRO PULSE ADVANTAGE: CLEANER PARTS NO CHEMICALS



STATOR

- 20 min in Trichlor
- Soils not removed

- Run in Goff 1316 Spinner
- 4 per load
- 30 second cycles
- Water only

MADE IN U.S.A.

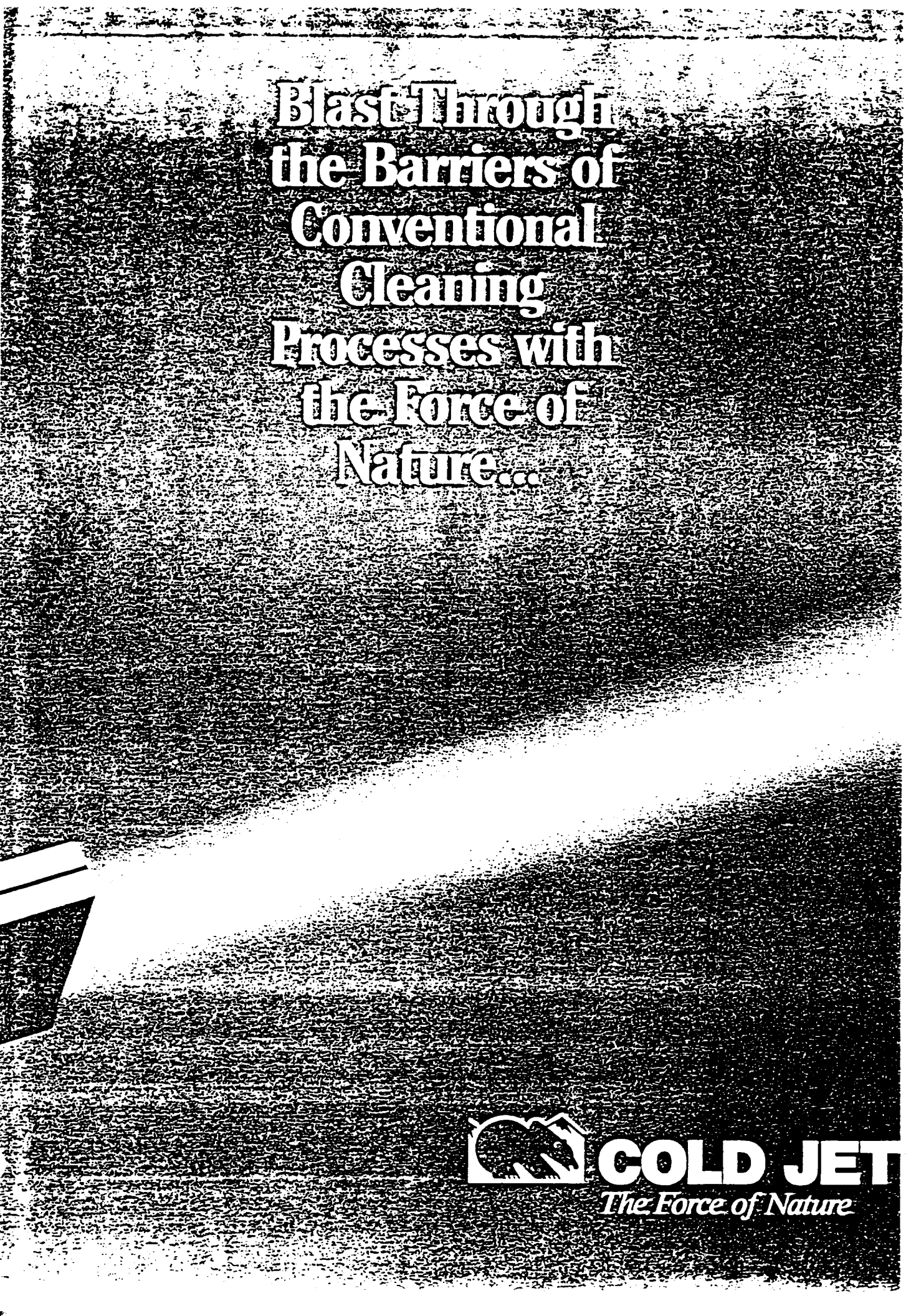
GOFF HydroPulse

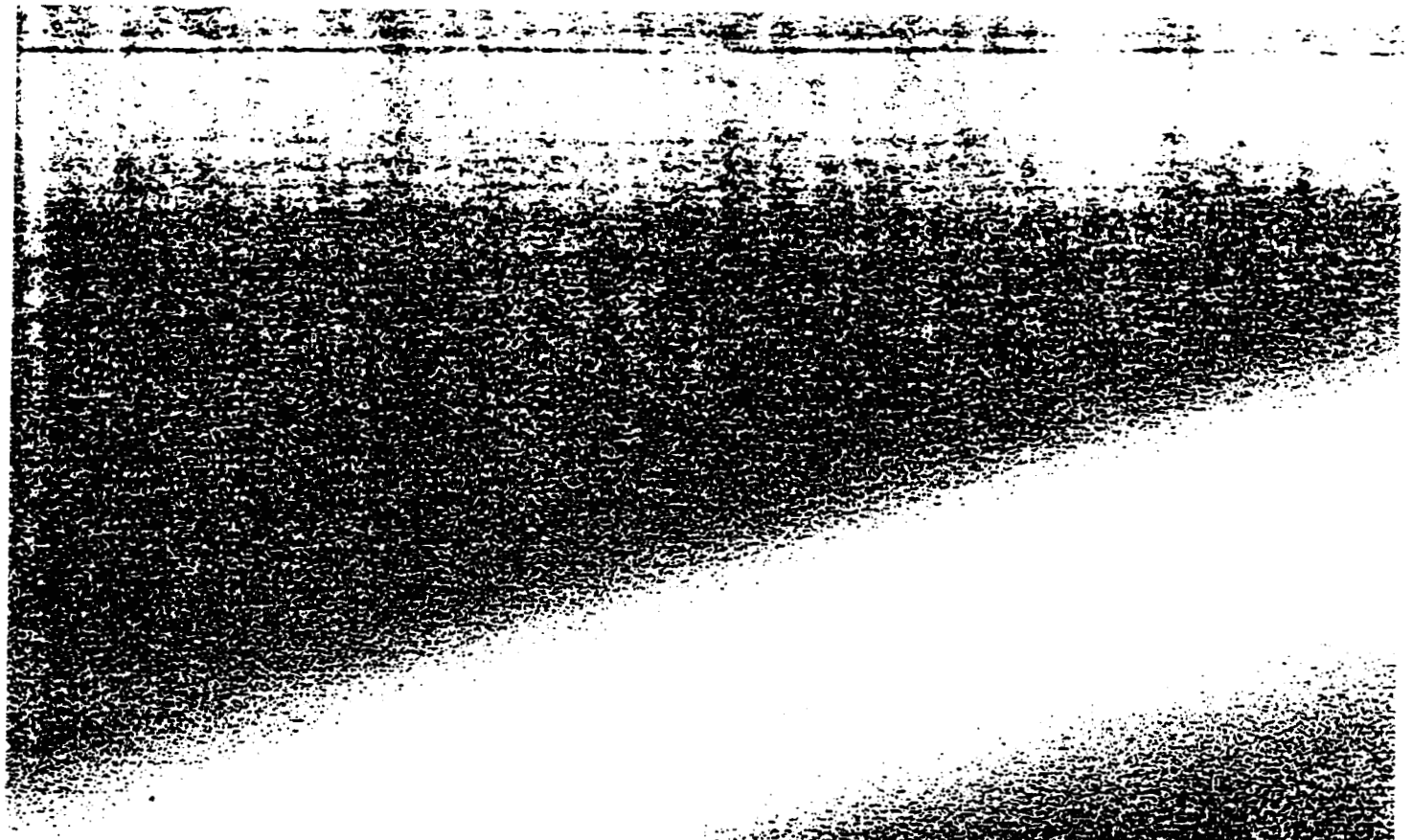
ANY QUESTIONS?

1-800-654-4633

GOFF CORPORATION

1 Pleasant Grove Rd • P O Box 1607 • Seminole, Oklahoma 74868 • Tel 405 382-6900 • FAX 405 382-7010


Blast Through the Barriers of Conventional Cleaning Processes with the Force of Nature...
COLD JET
The Force of Nature



ness the Force of Nature with
l Jet

operation depends on the conventional cleaning
ls of grit blast, steam, hazardous chemical solvents or
ve manual labor, Cold Jet, Inc. can improve your
tivity, maximize your equipment life and completely
te cleaning media disposal costs.

t is the revolutionary cleaning process that provides
oxic, non-hazardous solution to the problems
ted with conventional cleaning methods. This process
elletized carbon dioxide, or dry ice, as a blast media
natically remove residue from cleaning surfaces.

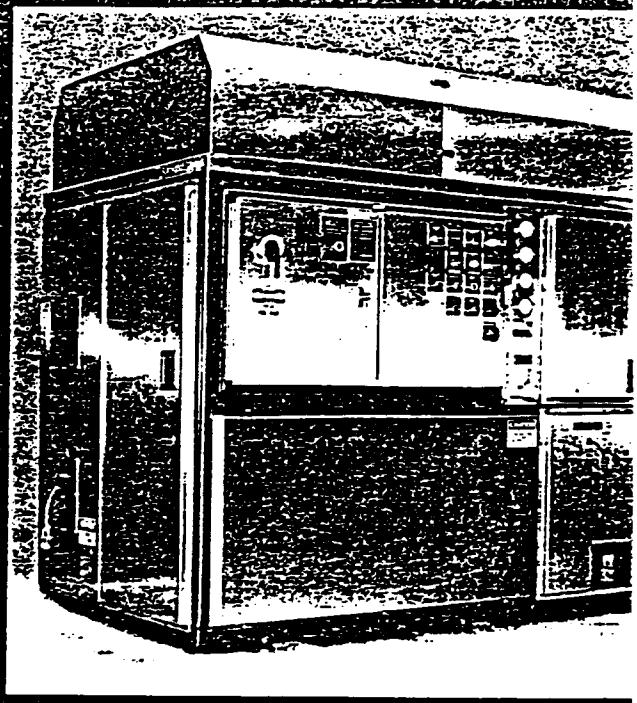
he dry ice pellets come in contact with the surface,
l shock, or fracking, occurs. This extreme change in
temperature severs the bond between the residue
cleaning surface to significantly reduce the cleaning
sociated with conventional methods.

ets disintegrate upon impact, extending equipment
nponent life by minimizing surface abrasion and
tensile strength deterioration. The residual carbon dioxide particles then dissipate into the atmosphere, eliminating any costs associated with conventional media reclamation and disposal.

Because carbon dioxide is a non-toxic, natural element, it is approved for industry use by the FDA, USDA and EPA. Used in the Cold Jet system, the carbon dioxide pellets are a non-flammable, non-conductive dry blast medium that will not damage electrical or mechanical parts.

Each Cold Jet system relies on three different principles — velocity, mass density flow and thermal shock. Optimum cleaning efficiencies are achieved through the regulation of these elements at the control panel or by the operator during manual applications.

The propellent stream may either be shop air or an inert gas. Pressure regulation achieves subsonic, sonic or supersonic velocities and the mass of carbon dioxide pellets in the propellent stream is adjusted by regulating feed rates. Volumetric flows are controlled using variable compressor settings. The degree of thermal shock can be accentuated or minimized, and is achieved when the carbon dioxide pellets come in contact with the surface being cleaned.



Each Cold Jet pelletizer unit undergoes strict quality con
testing procedures prior to shipping.

The Force of Nature is Unlimited

Following years of research and development, Cold Jet today designs, engineers, manufactures and installs cleaning systems in a diverse range of industries to meet a variety of challenges. From such intensive applications as the removal of layers of slag from automotive assembly rails — to such sensitive applications as the removal of flux from circuit boards, Cold Jet is revolutionizing the way industries approach their cleaning processes.

Cold Jet meets each new cleaning challenge because our engineering team has a broad range of system design experience across a wide spectrum of industries. From food processing to automotive manufacture; from electronics to aerospace, our expertise allows us to design and manufacture systems for mobile, fixed, manual or automated on-line applications. These capabilities provide our customers with a valuable ally in their battle to remain competitive in a constantly changing environment.

The Force of Nature Takes on Many Forms

Each system is comprised of four basic elements: a non-explosive tank of liquid carbon dioxide; a pelletizer, a propellent system and a nozzle assembly. These elements are then custom configured to meet the most demanding application challenge. Individual systems are designed to conform to each customer's specific requirements. Typical configurations involve either fixed or mobile units.

Fixed systems lend themselves to automated on-line applications. Whether used for equipment maintenance, cleaning or surface preparation, these systems contribute to increased production rates and performance. Cold Jet retrofits existing production lines or designs and integrates systems in new plant construction. These systems hard pipe liquid carbon dioxide from remote supply tank locations to single or multiple application sites.

Mobile systems lend themselves to manual applications at a variety of remote locations. Each mobile system is self-sufficient and transportable within a plant environment or outdoors. Components are mounted on towable trailers with a typical turning radius of 12 feet for easy maneuvering from one location to another.

Unleash the Force of Nature with Cold Jet...

To Provide a Safe Environment

Because carbon dioxide is a non-toxic element approved for industry use by the EPA, FDA and USDA, Cold Jet reduces or eliminates ongoing company liability and employee exposure to dangerous chemical cleaning agents when substituted for chemical wash processes.

To Reduce Costs

The fracking capabilities of Cold Jet dramatically shorten cleaning times associated with conventional processes, reducing labor costs while improving productivity.

Cold Jet's natural properties and superior cleaning capabilities eliminate the need to use hazardous materials because carbon dioxide pellets evaporate and dissipate into the atmosphere. Disposal costs are reduced in two ways:

First, there are no hazardous chemical solvents to be disposed of in accordance with stringent Federal, State and local guidelines.

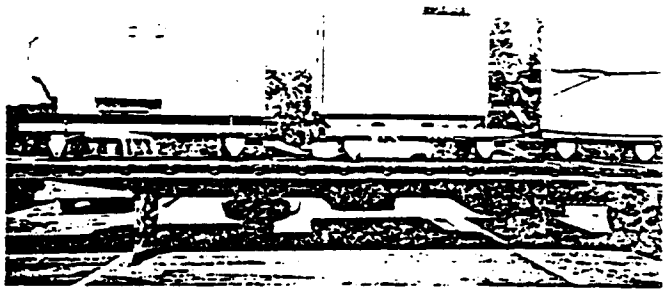
Second, conventional methods used to clean existing toxic materials or radioactive substances generate additional hazardous wastes because the medium becomes contaminated on contact. By using Cold Jet, only the hazardous material being cleaned requires disposal.

To Increase Production

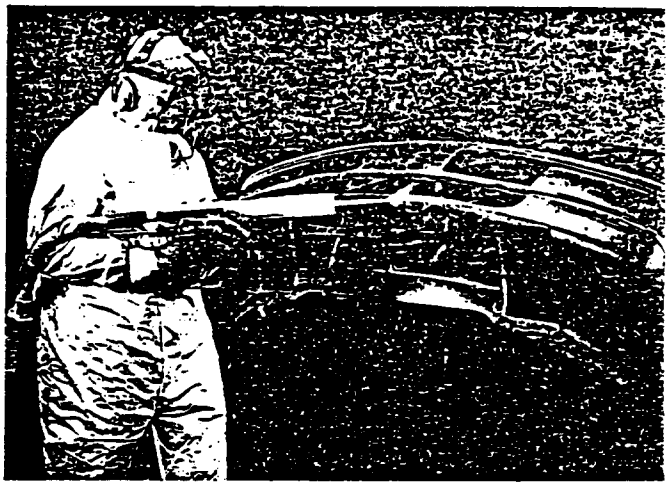
Production schedule interruptions, or the removal of components for cleaning purposes can be eliminated by integrating your production line with manual, automated or robotic Cold Jet systems. Dedicated cleaning cycles can be eliminated and preventive maintenance schedules can be implemented to provide for equipment maintenance during production. The dramatically reduced cleaning time of Cold Jet increases throughput without adding labor or extensive capital equipment.

To Extend Equipment Life

Because frozen carbon dioxide has negligible molecular integrity, Cold Jet pellets shatter upon impact, reducing equipment and component wear by minimizing the surface degradation normally occurring with the use of conventional blast media. Cold Jet's dramatically superior cleaning rates reduce cleaning time, allowing materials to be cleaned more frequently with less harm to surfaces.



Self-sufficient Cold Jet mobile systems are towable and have a typical turning radius of 12 feet for easy maneuvering either within a plant environment or outdoors.



This automotive bumper mold is one example of the many superior cleaning capabilities of the Cold Jet system.

Cold Jet systems are currently being used across a broad spectrum of industries to improve performance and reduce production costs.

ustaining the Force of Nature

ıile Cold Jet is providing this revolutionary technology to dustries throughout the world, we maintain our mmitment to extensive, ongoing research and velopment, allowing us to meet the emerging challenges sociated with rapidly evolving technologies in the dustrial marketplace.

ıgoing research projects are being conducted by some of e most prestigious third-party organizations in the world. ıese programs provide both qualitative and quantitative .ta to Cold Jet and our customers. One such program being nducted by Battelle Memorial Institute, the world's largest ivately funded research institute, is evaluating long-term ress fatigue when using Cold Jet applications on uminum and composite panels for the commercial and ilitary aerospace industries.

another program, the Production Engineering Research ssociation of Great Britain, or PERA, is providing etallurgical, performance and safety data regarding Cold t applications in European aerospace, defense and energy stallations. PERA, formed in 1946, is a multi-disciplined chnology center with membership comprised of over 1,200 ritish and European companies.

om the United States to the far reaching corners of the orld, our commitment to meeting the challenges of volving technologies remains constant.

upporting The Force of Nature

ach Cold Jet system installation is backed by extensive erformance guarantees, comprehensive training programs or equipment users and a nation-wide support organization.

old Jet enjoys an ongoing association with Liquid Carbonic arbon Dioxide Company, the world's largest supplier of bulk arbon dioxide. This affiliation allows us to provide our ustomers with sales, installation and service assistance as ell as a secure supply of liquid carbon dioxide.

The Force of Nature Versus Conventional Cleaning Methods

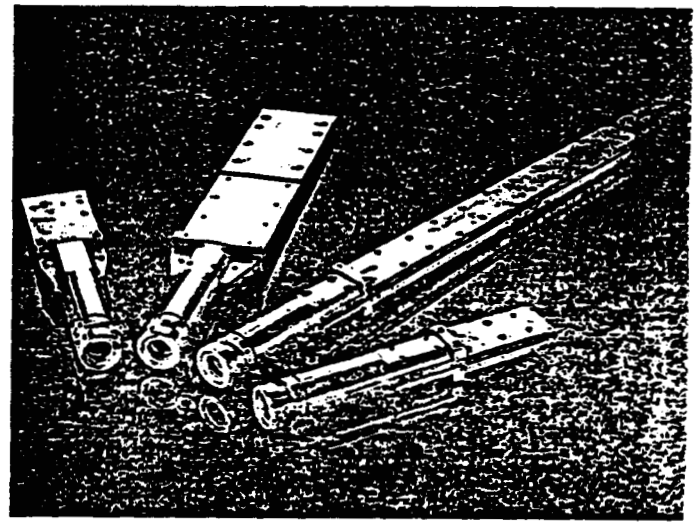
Method	Abrasive	Disposal	Performance	Toxic	Conductive
Cold Jet	no	no	superior	no	no
Sand	yes	yes	moderate	no*	no
Glass Bead	yes	yes	moderate	no*	no
Walnut Shell	yes	yes	limited	no*	no
Steam	no	no	inferior	no	yes
Chemical Solvents	no	yes	limited	yes	yes

* If used to clean hazardous materials, this medium is contaminated upon contact — becoming toxic waste requiring safe disposal.

For more information, or to receive a copy of our demonstration video, call or write:

(513) 831-3211

Cold Jet, Inc.
455 Wards Corner Road
Loveland, Ohio 45140



Cold Jet can custom-configure nozzles for automated on-line applications as well as provide a variety of standard nozzle assemblies for manual applications.

COLD JET, INC.

The Force of Nature

Cold Jet systems use dry ice pellets as a blasting medium to safely and economically clean, depaint and prepare many surfaces with no media waste generation or disposal.

Unlike grit, chemicals or particle blasting, dry ice pellets vaporize, leaving only the removed contaminant for disposal. Clean-up time is dramatically reduced, along with the expense and on-going liability associated with disposing of the cleaning media.

Dry ice is a non-toxic natural element; approved for industry use by the FDA, USDA and the EPA, carbon dioxide is non-conductive, non-abrasive, non-explosive, non-invasive and non-flammable. Decrease on-going employee liability by eliminating cleaning agent residue, hazardous dust and toxic chemical vapors.

Should you have any additional questions, please give us a call at your earliest convenience.

COLD JET FIXED INSTALLATION
GENERAL SYSTEM SPECIFICATIONS

COLD JET SYSTEM

Model 65-100

Length: 75 Inches

Width: 48 Inches

Height: 73 Inches

Weight without Dryer: 3750 Lbs

Power Requirements: 460 volts; 40 Full Load Amps; 60 Hz; 3-Phase; 15 Kilowatts per Hour

Approximated CO_2 Usage: 360-1450 Lbs. per Hour (Continuous Operation)

Standard Blast Hose Length: Up to 200 feet

Internal Dryer: 350 P.S.I. @ 330 C.F.M and Max. Dew Point of -40 Degrees Fahrenheit

Internal Dryer Weight: Approx. 450 Lbs.

Internal Dryer Power Requirements: 115 Volts; 1 Full Load Amp; 60Hz; 1-Phase; 0.10 Kilowatts per Hour

AUXILIARY EQUIPMENT

Air Compressor

Recommended Pressure and Flow: 250 P.S.I @ 330 C.F.M.

Compressor Weight: 4400 Lbs.

Compressor Power Requirements: 460 Volts; 156 Full Load Amps; 60Hz; 3-Phase; 112 Kilowatts per Hour

Liquid CO_2 Tank

Capacity: 12-50 Ton LCO_2

Weight: 42,000-140,000 Lbs. Fully Loaded

Power Requirements: 460 volts; 20-50 Full Load Amps; 60 Hz; 3-Phase;
14 Kw @ 20 Amps; 36 Kw @ 50 Amps

Total Power Consumption of Cold Jet System: 460 Volts, 197* Full Load Amps., 60 Hz., 3-Phase

*Does not include CO_2 Tank

COLD JET FIXED INSTALLATION
GENERAL SYSTEM SPECIFICATIONS

COLD JET SYSTEM

Model 65-150

Length: 100 Inches

Width: 48 Inches

Height: 73 Inches

Weight without Dryer: 4650 Lbs

Power Requirements: 460 volts, 40 Full Load Amps., 60 Hz., 3-Phase, 18 Kilowatts per Hour

Approximated CO_2 Usage: 360-2900 Lbs. per Hour (Continuous Operation)

Standard Hose Length: Up to 200 feet

Internal Dryer: 290 P.S.I. @ 850 C.F.M and Max. Dew Point of -40 Degrees Fahrenheit

Internal Dryer Weight: Approx. 1600 Lbs.

Power Requirements: 115 Volts, 2 Full Load Amps., 60Hz., 1-Phase, 0.10 Kilowatts per Hour

AUXILIARY EQUIPMENT

Air Compressor

Recommended Pressure and Flow: 290 P.S.I @ 850 C.F.M.

Compressor Weight: 7694 Lbs.

Compressor Power Requirements: 460 Volts, 361 Full Load Amps., 60 Hz., 3-Phase, 259 KW per hour

Liquid CO_2 Tank

Capacity: 12-50 Ton LCO_2

Weight: 42,000-140,000 Lbs. Fully Loaded

Power Requirements: 460 volts, 20-50 Full Load Amps., 60 Hz., 3-Phase
14 Kw @ 20 Amps; 36 Kw @ 50 Amps

Total Power Consumption of Cold Jet System: 460 Volts, 403* Full Load Amps., 60 Hz., 3-Phase

*Does not include CO_2 Tank

COLD JET FIXED INSTALLATION
GENERAL SYSTEM SPECIFICATIONS

COLD JET SYSTEM

Model 65-200

Length: 100 Inches

Width: 48 Inches

Height: 73 Inches

Weight without Dryer: 4650 Lbs

Power Requirements: 460 volts, 40 Full Load Amps., 60 Hz., 3-Phase, 18 Kilowatts per Hour

Approximated CO_2 Usage: 360-2900 Lbs. per Hour (Continuous Operation)

Standard Hose Length: Up to 200 feet

Internal Dryer: 290 P.S.I. @ 850 C.F.M and Max. Dew Point of -40 Degrees Fahrenheit

Internal Dryer Weight: Approx. 1600 Lbs.

Power Requirements: 115 Volts, 2 Full Load Amps., 60Hz., 1-Phase, 0.10 Kilowatts per Hour

AUXILIARY EQUIPMENT

Air Compressor

Recommended Pressure and Flow: 290 P.S.I @ 850 C.F.M.

Compressor Weight: 7694 Lbs.

Compressor Power Requirements: 460 Volts, 361 Full Load Amps., 60 Hz., 3-Phase, 259 KW per hour

Liquid CO_2 Tank

Capacity: 12-50 Ton LCO_2

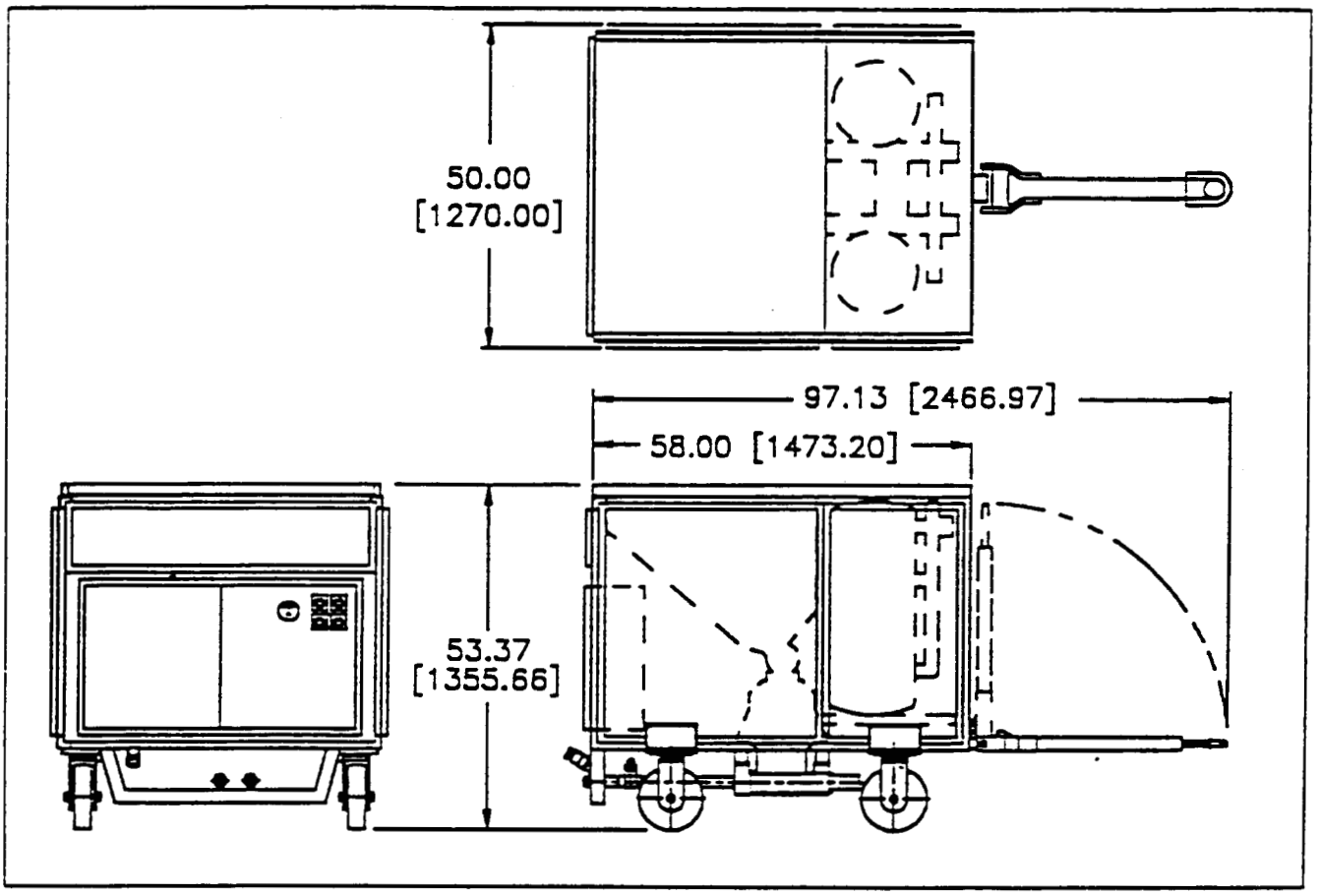
Weight: 42,000-140,000 Lbs. Fully Loaded

Power Requirements: 460 volts, 20-50 Full Load Amps., 60 Hz., 3-Phase
14 Kw @ 20 Amps; 36 Kw @ 50 Amps

Total Power Consumption of Cold Jet System: 460 Volts, 403* Full Load Amps., 60 Hz., 3-Phase

*Does not include CO_2 Tank

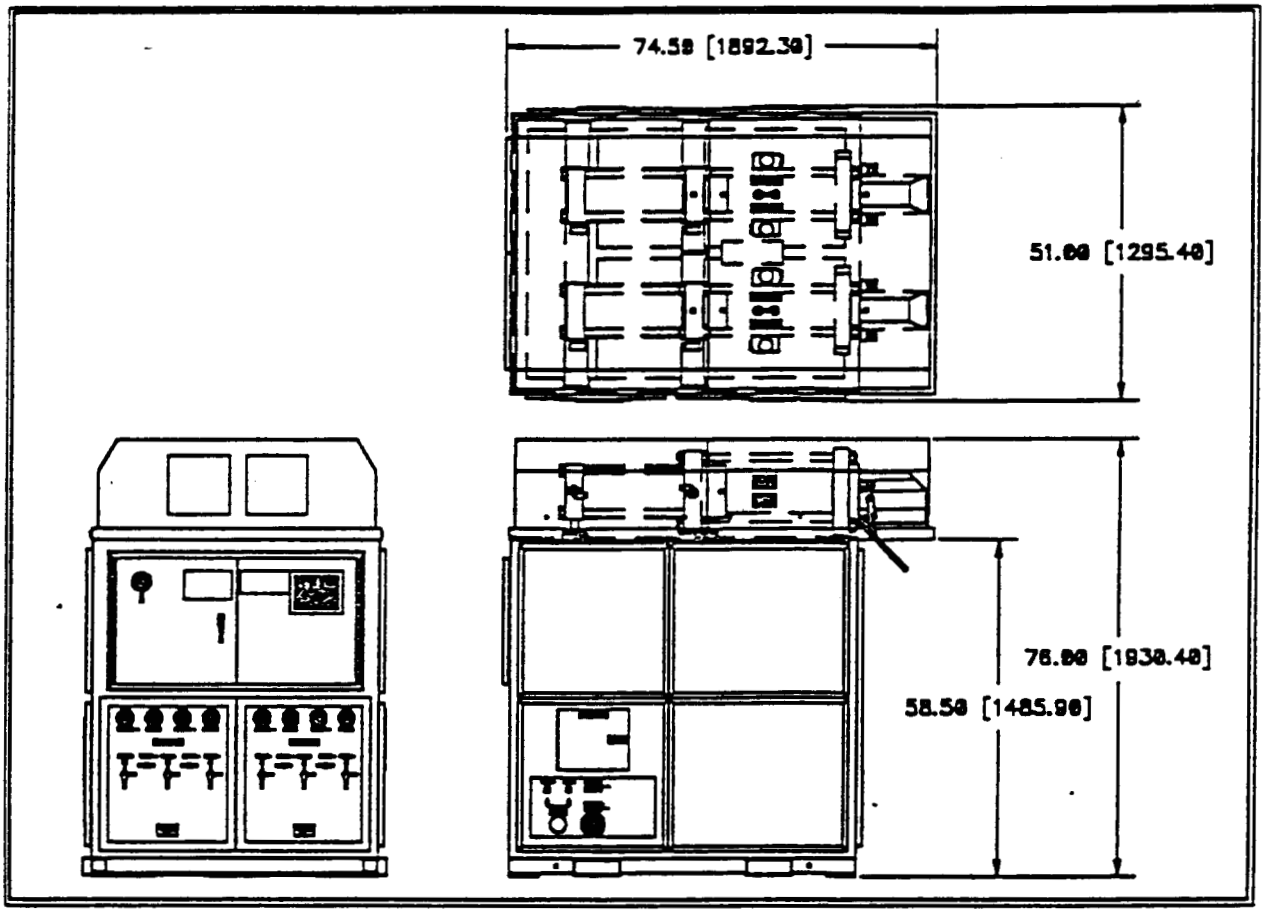
COLD JET
RDS 1000 Remote Delivery System



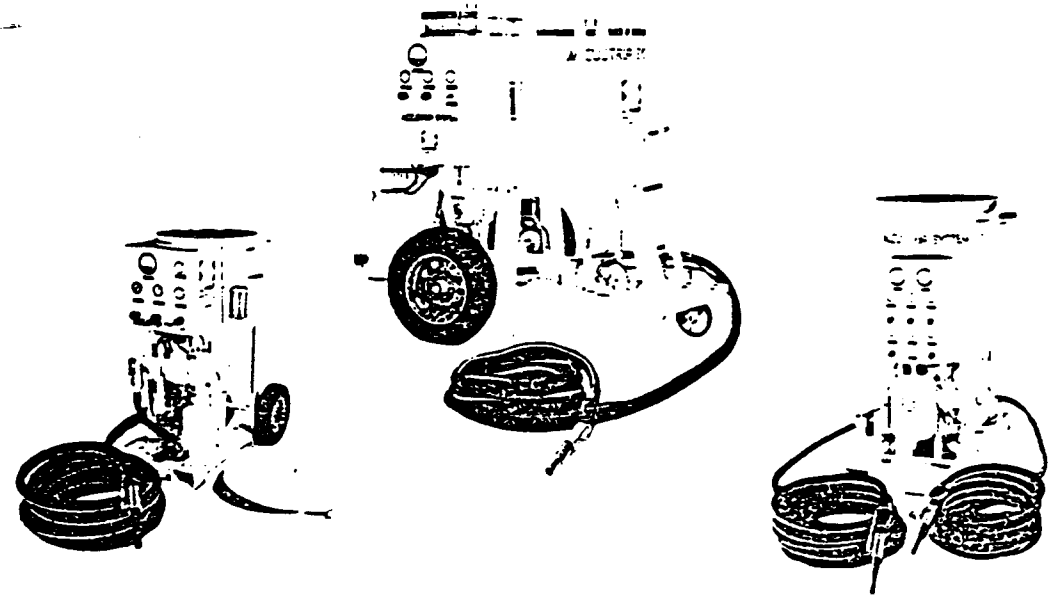
LENGTH: 97.12 with tow bar extended; 58" with tow bar stowed WIDTH: 50" HEIGHT: 53.37"

WEIGHT:	Approximately 1500 pounds dry
CO_2 PELLET CAPACITY:	640 pounds
PELLET BLAST FLOW CAPACITY:	Up to 1000 pounds per hour
EFFECTIVE OPERATING PRESSURE RANGE:	80 psig @ 150 CFM to 300 psig @ 350 CFM
OPTIONAL AIR DRYER:	350 psig @ 330 CFM and maximum dewpoint of -40 degrees Fahrenheit
POWER REQUIREMENTS:	120 VAC, 1-Phase, 15 Amps Full Load
STANDARD BLAST HOSE LENGTH:	Up to 200 feet
CONSTRUCTION:	All welded steel frame and stainless steel panels Teflon lined stainless steel hopper
CASTERS:	Standard industrial urethane tires on steel wheels

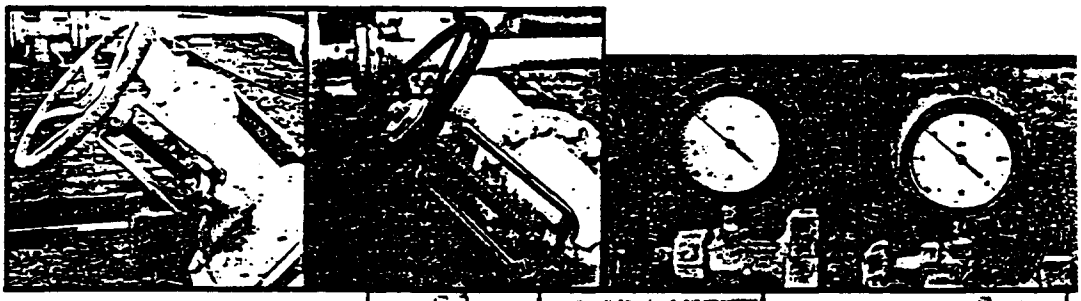
COLD JET, INC.
PPAH-1500 Dry Ice Pelletizer



CO_2 PELLET PRODUCTION RATE:	Variable - 165 to 1500 pounds per hour
CO_2 PELLET DIAMETER RANGE:	0.125 to 0.438 inches diameter (interchangeable die plates)
LENGTH: 74.50 inches - WIDTH: 51 inches - HEIGHT: 76 inches	
WEIGHT:	Approximately 3500 pounds dry
POWER REQUIREMENTS:	460 Volts, 3-Phase, 30 FLA, 60 Hz
APPROXIMATED CO_2 USAGE:	360 - 2900 pounds per hour
CONFIGURATION:	Two Pelletizer Cylinders Two Pellet Loading Chutes Independent or coordinated pelletizer operation
PELLET LOAD HEIGHT:	54 inches maximum
CONSTRUCTION:	All welded steel frame and stainless steel panels



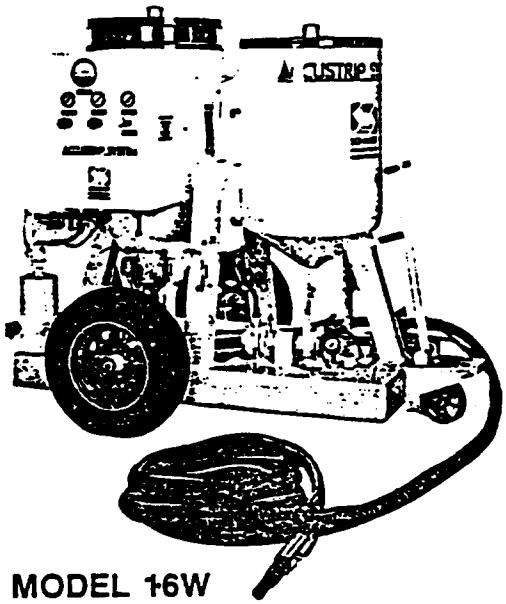
ACCUSTRIP SYSTEM™



The ACCUSTRIP SYSTEM™, manufactured by SCHMIDT MANUFACTURING, INC., using ARMEX® BLAST MEDIA, is the safest and most effective ma[illegible] available in the wor[illegible]

SCHMIDT
MANUFACTURING
INCORPORATED

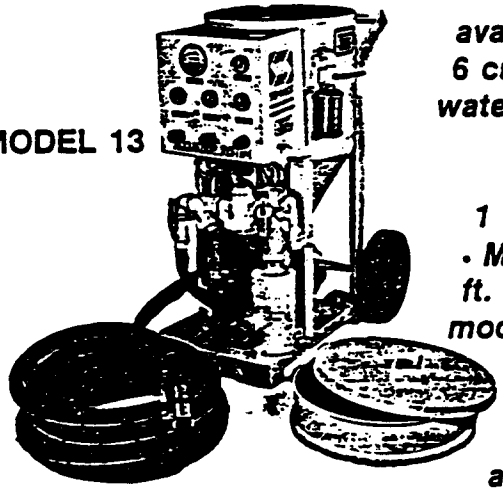
Engineered and manufactured by SCHMIDT MANUFACTURING, INC., the ACCUSTRIP SYSTEM™ is a depainting and degreasing method that overcomes the inherent problems of its predecessors. Utilizing ARMEX® Blast Media, manufactured by the makers of ARM & HAMMER® products, the ACCUSTRIP SYSTEM™ effectively works on substrates that previously required harsh chemicals, protected environments, or simply could not be done at all. Because of the nontoxic and nonsparking qualities of the ACCUSTRIP SYSTEM™, you are now able to perform depainting and degreasing maintenance in one step, in the field, in hazardous duty areas, and without costly downtime. Also, the ACCUSTRIP SYSTEM's unique application of water injection at the nozzle, utilizing ARMEX® Blast Media, enables you to depaint and degrease equipment without damage to machined parts or bearings. The variety of substrates ideally suited to this application ranges from exotic composites to concrete. From hydrocarbon processing and automotive to public utilities and the aerospace industry, application after application is being uncovered. SCHMIDT's reputation for innovation and quality in the blasting industry is evident in the design and construction of the ACCUSTRIP SYSTEM™. This system is safer for the operator and the environment than any other offered in the world today.



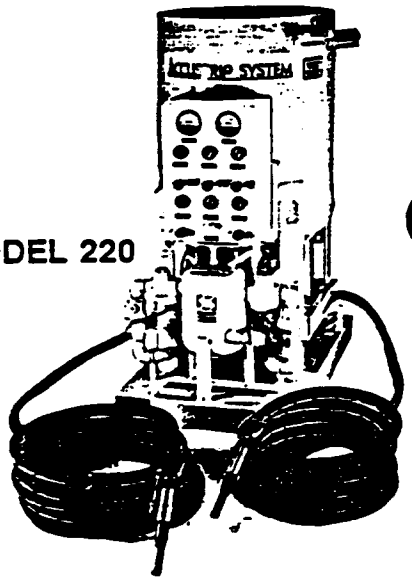
MODEL 16W

ACCUSTRIP SYSTEM™

As of this printing, there are four standard ACCUSTRIP SYSTEMs available: • Model 16W, 1 operator 6 cubic ft. media tank with 40 gal. water tank • Model 16, 1 operator 6 cubic ft. media tank (not pictured) • Model 13, 1 operator 3 cubic ft. media tank • Model 220, 2 operators 20 cubic ft. media tank. All models include modified 149 Thompson valves, so the operator can have total control of the media flow from the control panel. Each model also comes complete with 50 ft. of blast hose and high pressure water hose with water injection blast head for each outlet.



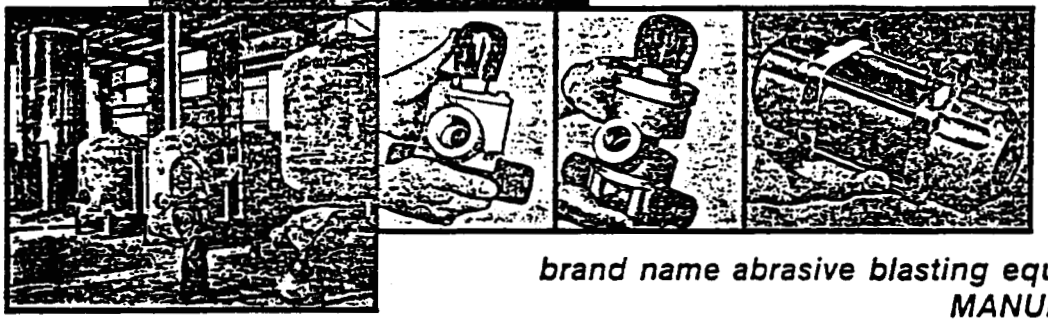
MODEL 13



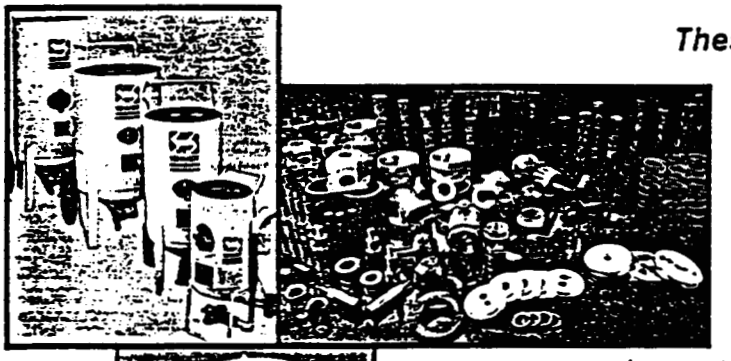
DEL 220

SCHMIDT MANUFACTURING INCORPORATED

SCHMIDT MANUFACTURING, INC. was established in [illegible] and earned an international reputation as a major manufacturer and innovator of abrasive blasting equipment. Located in Pasadena, Texas, a suburb of Houston, SCHMIDT's 11 acre complex reflects the pride they take in producing quality products. Their certified ASME code manufacturing facility is staffed with only the finest craftsmen. Management also chose the engineering, marketing and support teams with the same critical eye. The SCHMIDT manufacturing team has been called upon by some of the largest companies in the world for custom-made equipment and engineered systems. From the smallest blasting pot to the largest self contained blast room, their engineering experience is second to none. SCHMIDT MANUFACTURING, INC.'s patented valves are considered the finest in the industry and are frequently used by other manufacturers of brand name abrasive blasting equipment. SCHMIDT MANUFACTURING, INC.'s equipment is primarily sold through a worldwide distributor network. These distributors are supported with field training, in-house seminars and an on-going program of marketing material on all products and current innovations. SCHMIDT stocks parts for all the equipment they manufacture. Whether it's off-the-shelf blasting equipment, custom-made equipment, engineered systems, ACCUSTRIP SYSTEMs, or any of their patented valves, SCHMIDT MANUFACTURING, INC.'s quality products and quick response after the sale are the mainstays of their reputation.



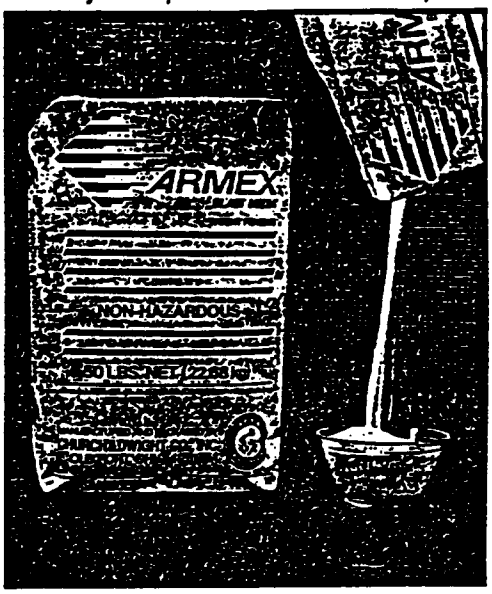
COMPANY PROFILE



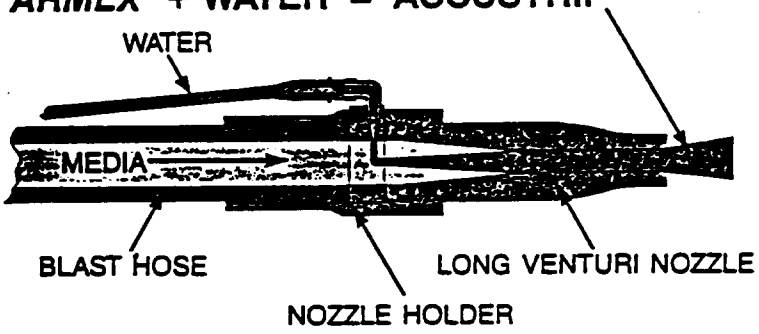
SCHMIDT MANUFACTURING INCORPORATED

MEDIA

ARMEX® Blast Media[1], manufactured by the makers of ARM & HAMMER®[2] products, is an odorless, white crystalline material posing virtually no health or combustion hazards when used as directed. The ARMEX® crystal possesses a unique combination of hardness, specific gravity and pH, giving it exceptional capabilities for depainting and degreasing when used with the ACCUSTRIP SYSTEM™.



ARMEX® + WATER = ACCUSTRIP™



SPECIFICATIONS

ACCUSTRIP SYSTEM™

WATER FLOWRATE	.5 gpm
MEDIA FLOWRATE	60 lbs. - 240 lbs. per hr.
PRODUCTION RATE*	1.5 - 2.5 sq. ft. per min.
PRESSURE RANGES	10 - 100 psi

* PARAMETERS BASED ON URETHANE TYPE COATINGS UP TO 4 MILS

ACCUSTRIP DIMENSIONS

MODEL	OA LENGTH		OA WIDTH		OA HEIGHT		APPROX. DRY WEIGHT	
	IN.	(CM)	IN.	(CM)	IN.	(CM)	LBS.	(KGS)
16W	66	(170)	54	(137)	64	(185)	1210	(549)
16	36	(91)	32	(81)	56	(142)	810	(367)
13	44	(112)	34	(86)	54	(137)	710	(322)
220	56	(142)	38	(97)	80	(203)	1920	(871)

SCHMIDT MANUFACTURING INCORPORATED

FLEXIBILITY → *The unretouched photos on this page feature just a few of the applications for which the ACCUSTRIP SYSTEM™ is the preferred, and sometimes the only, method of depainting and/or degreasing.*

THE FOLLOWING ITEMS ARE EXAMPLES OF THE VARIETY OF MATERIALS THE ACCUSTRIP SYSTEM™ CAN DEPAINT AND/OR DEGREASE WITHOUT COSTLY DOWNTIME; IN SOME CASES IT IS THE ONLY METHOD WHICH WILL PRODUCE A LIKE NEW FINISH.

- *Concrete*
- *Cast Stainless Steel*
- *Cast Aluminum And Glass*
- *Cast Iron*
- *Thin Gauge Aluminum And Galvanized Steel*
- *Aviation Alloy And Adhesives*
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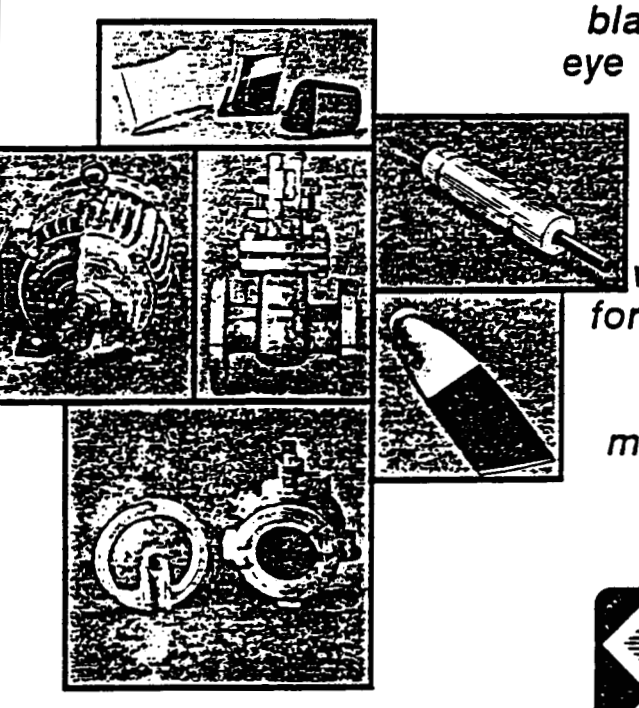
FEATURES

USER FRIENDLY →



From media flow to blast pressure, the eye level instrument panel gives the operator total system control. Less protective wear is required for the operator of the ACCUSTRIP SYSTEM™, making him more comfortable and productive.

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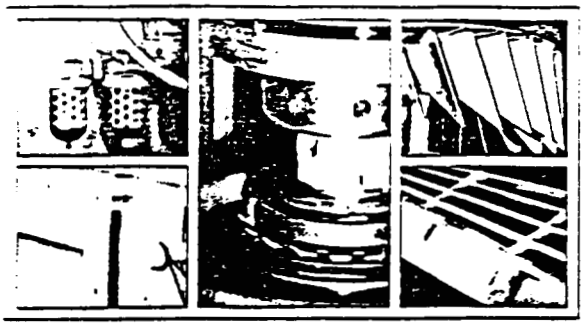
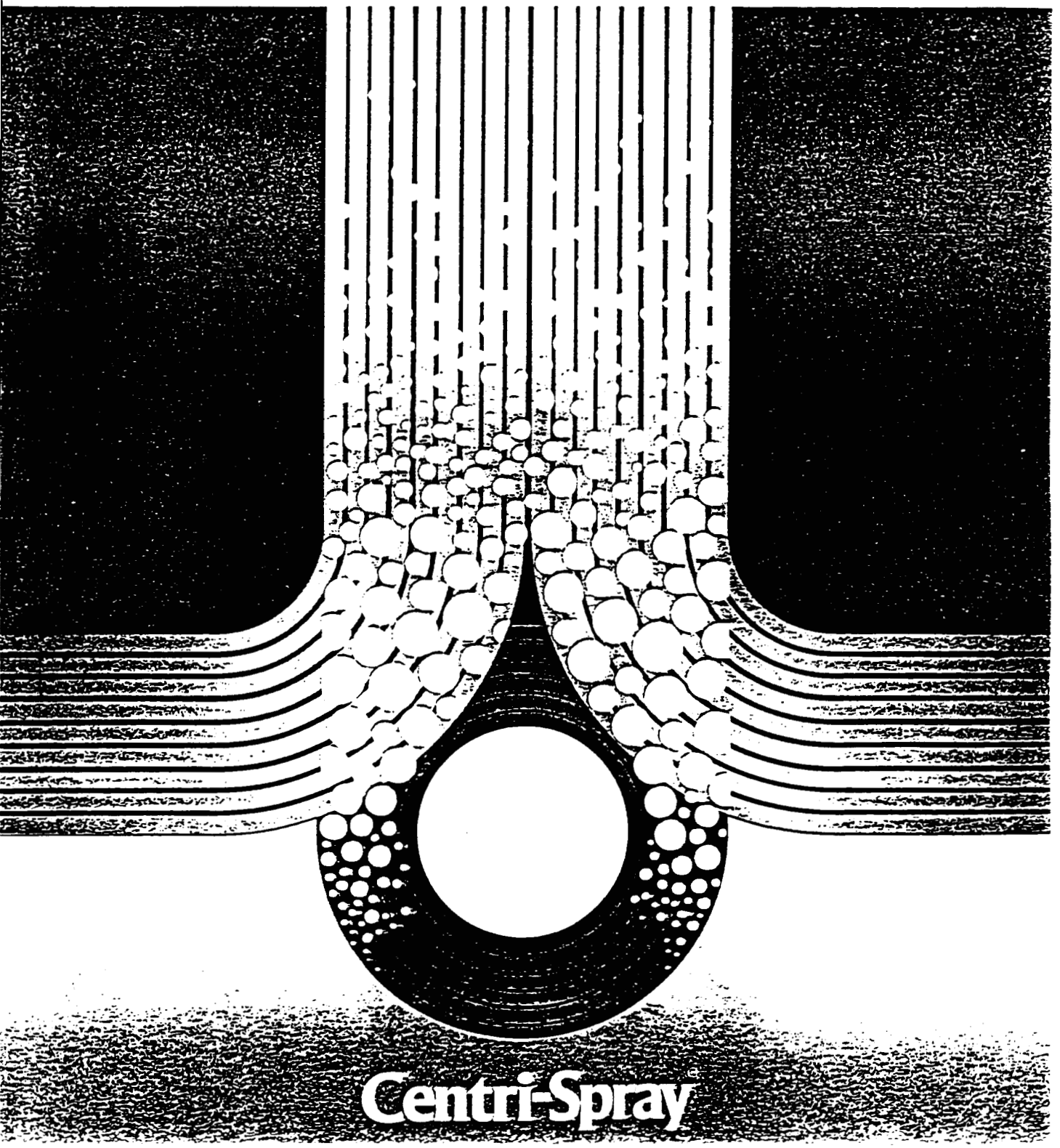
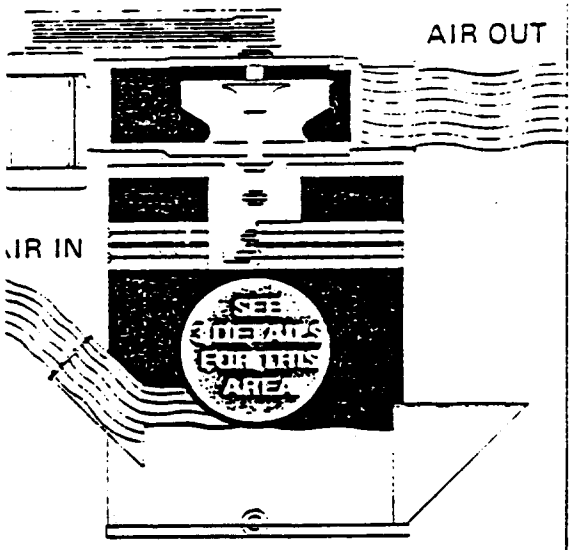
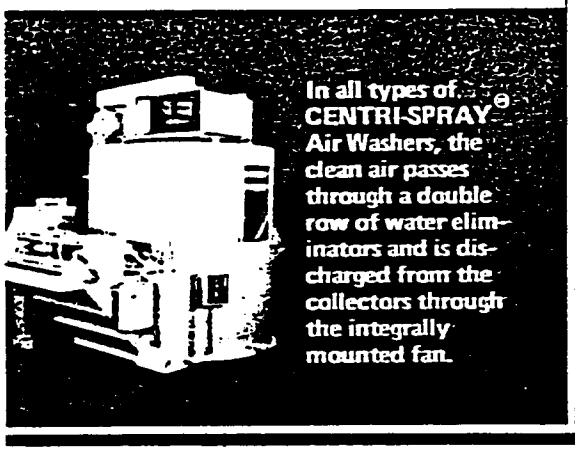


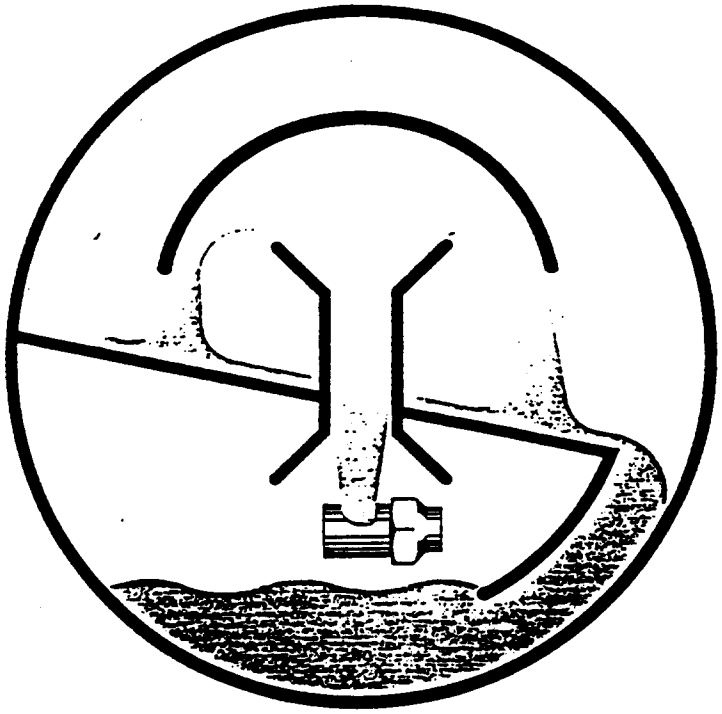
Wet-Type High Energy Air Washers



Wet-Type Air Scrubbe







Venturi Type

The Modular Venturi is a high efficiency collector with moderate to low pressure drop requirement. One Venturi module is used for each 5,000 CFM capacity and insures reliable operation and uniform efficiency.

HOW IT WORKS

A recirculating pump feeds water to the non-clogging jet positioned at each Venturi inlet. The air stream induces the jet water into the throat of the Venturi where the turbulent mixing of the air and water occurs. The expanding air-water mixture is then impinged on the modular Venturi discharge cover which turns the air stream 180° and completes the wash operation.

STANDARD APPLICATIONS

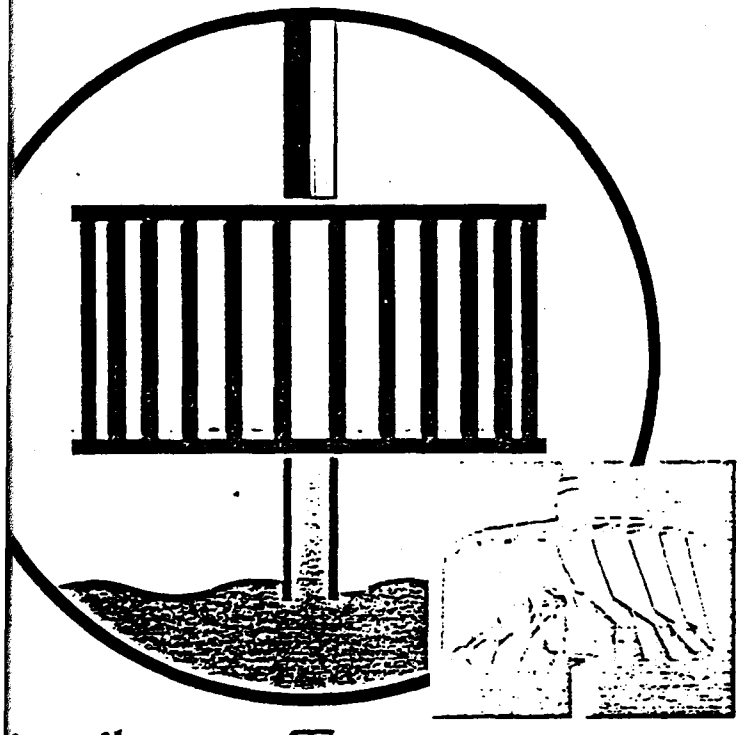
Oil Mist
Foundry Dust and Sand
Engine Exhaust
Machining Operations
Grinding Operations

T BOTTOM OR CONE TOM STYLE

CENTRI-SPRAY Air Washer is made in two basic gurations: flat bottom and cone bottom. The most nonly used is the flat bottom unit with its self- ined reservoir.
one bottom Air Washer is available for use where the oad is excessively heavy, as in foundry operations or e the unit must be exposed to below freezing tempo- res. The cone bottom unit is the same as the flat m style in every respect, except the water reservoir is raining at shut down.

Centri-Spray Air Washer is the most efficient unit of nd available. The unit is available in capacities from CFM to 40,000 CFM and requires minimum pressure Water consumption is only that amount required to e evaporation loss. The horsepower requirement of ir Washer depends on the efficiency required. Air ers for industry are proven by over 30 years history undreds of successful installations.

CENTRI-SPRAY CORPORATION



istributor Type

Rotating Distributor Air Scrubber is a proven ctive way of generating a high efficiency water n of a contaminated air stream.
collector operates with an extremely low pressure p through the unit since the cleaning is achieved by velocity of a mechanically generated water pattern.

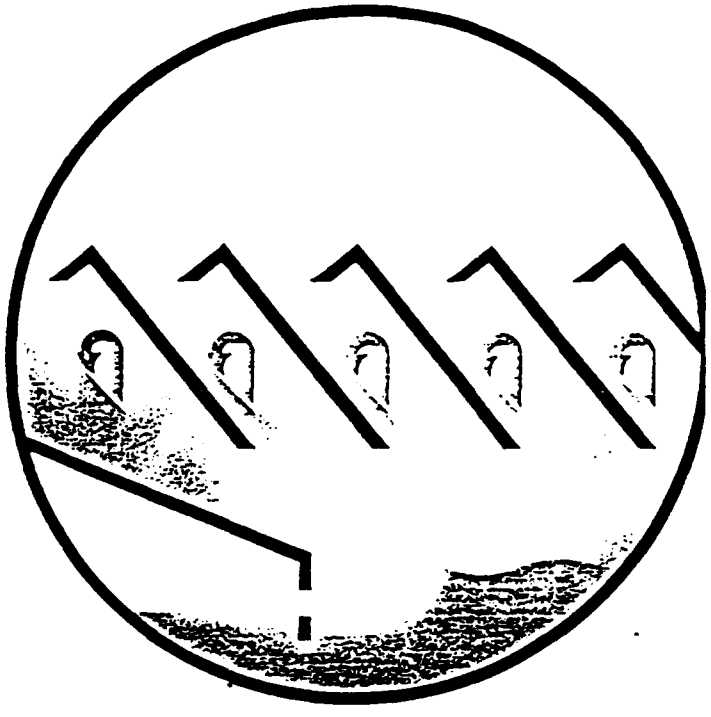
W IT WORKS

fan shaft is connected, for direct drive, to the lower butor and pump shaft. The pump, operating vertically e solution tank, lifts a large volume low pressure water y to the mechanical distributor which in turn generates a velocity horizontal spray pattern. The spray pattern is rated from the center of a tubular cleaning duct through n all the contaminated air flows.

collector type is furnished with either of two distrib- designs. As shown in the insert pictures, the standard r blade-type unit is selected depending on the soil. and belt polish exhaust uses the blade style unit to re self-cleaning operation.

NDARD APPLICATIONS

Iron Machining
and Polish
Overspray Collection
and Sand Handling, etc.
list



Impingement Type

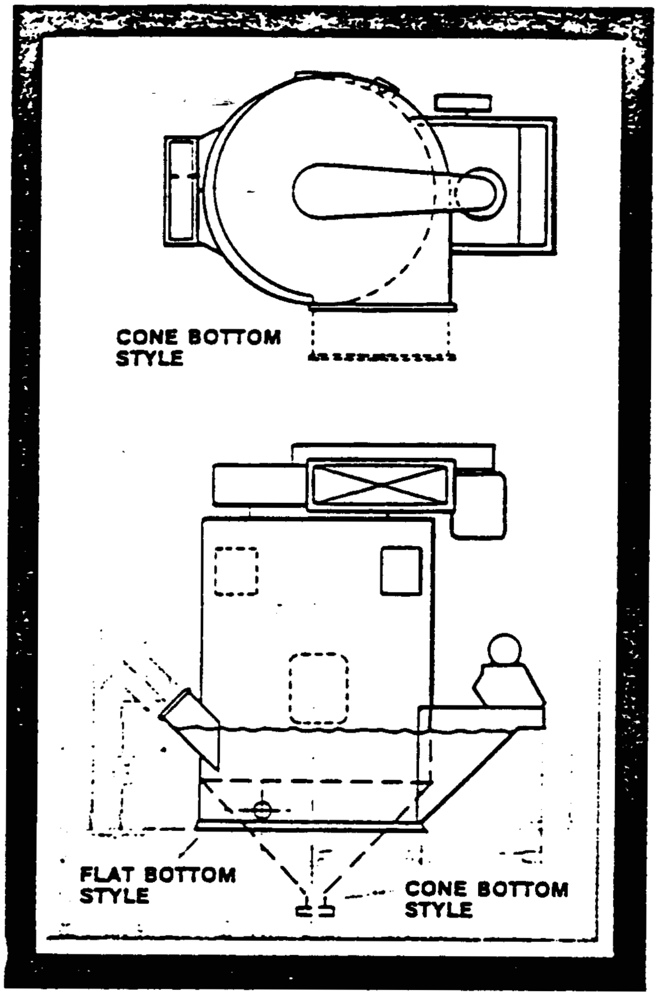
The Impingement Air Scrubber incorporates the simplest principle of operation to achieve clean air from various industrial applications. The unit has the ability of being efficiently applied to a wide range of air-borne contaminants. The wide acceptance of this collector, in the few years that it has been on the market, is attributed to the fact that the fan is the only moving component.

HOW IT WORKS

The air inlet of the Impingement Collector incorporates a segmented plenum which compresses the incoming air against the surface of the water in the collector tank. This plenum generates contact between the air and water and the pressure drop at this point induces a large volume of water into the air stream. The wetted air then passes through impingement vanes to insure complete washing of the intrained soil. For proper operation the water level must be maintained to a plus or minus one inch tolerance.

STANDARD APPLICATIONS

Cast Iron Machining
Buff and Polish
Dust and Sand Handling
Leather and Rubber Dust



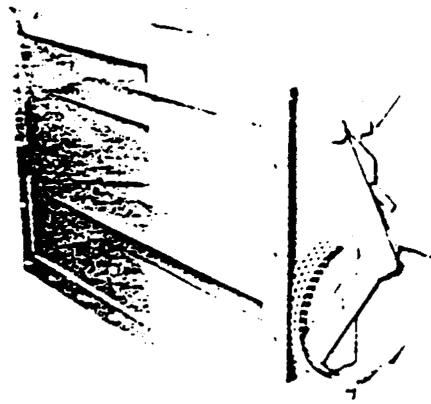
FOR CERTIFIED DIMENSIONS CONTACT CENTRI-SPRAY

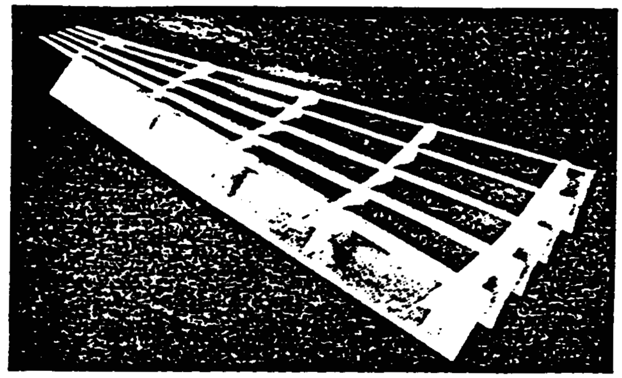
	5,000 C.F.M.	10,000 C.F.M.	15,000 C.F.M.	20,000 C.F.M.	25,000 C.F.M.	30,000 C.F.M.	35,000 C.F.M.	40,000 C.F.M.	45,000 C.F.M.
A	50	72	87	100	108	120	126	141	144
B	99	136	142	157	164	175	187	201	223
C	81	103	108	119	122	133	142	149	171
D	10	18	20	24	24	24	24	30	30
E	30	38	40	45	51	51	51	60	60
F	14	17	18	21	30	30	30	26	26
G	33	46	58	62	66	73	78	86	88
H	44	54	56	61	61	65	75	73	79
I	9	14	18	20	20	22	24	26	32
J	24	36	40	48	60	66	72	72	69
K	28	32	32	38	41	41	41	45	45
L	13	12	12	12	12	12	12	15	15
M	86	101	105	112	117	124	132	134	138

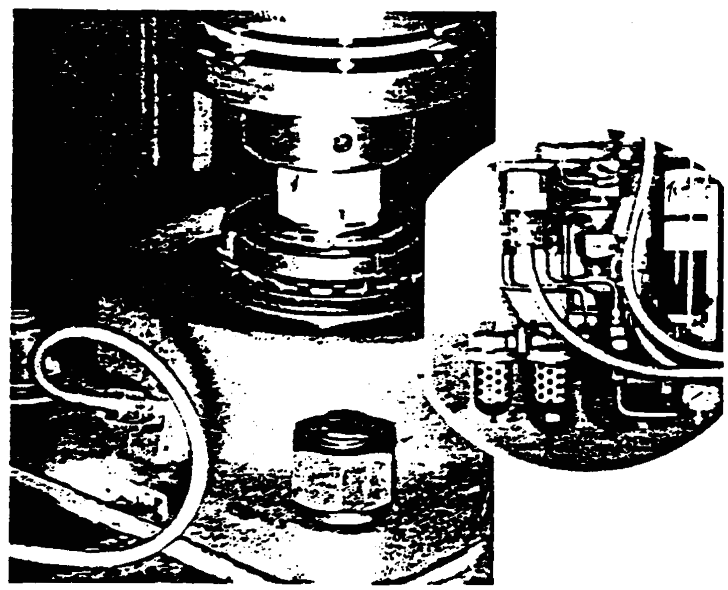
OTHER SIZES AVAILABLE

CENTRI-SPRAY® Wet Scrubber installations have consistently proven to meet all applicable State and Federal standards. Experienced Professional Sales Engineering, and Laboratory personnel are available to assist you in the selection of appropriate collection equipment to meet your specific requirements.

Where chemical additives will enhance and/or sustain the performance of a wet scrubber application, suitable chemical products are available from the Ajem® Laboratories Division of the CENTRI-SPRAY® CORPORATION. A staff of specialized chemists and engineers, chemical laboratory facilities, and product test kits complement the service available for your air pollution control needs.







1 *AIR DISCHARGE DAMPER*

An Air Discharge Damper should be included with each Air Washer to balance the system and ensure operating efficiency.

2 *MOISTURE ELIMINATORS*

Moisture eliminators can be high molecular weight polypropylene, as shown in Figure 2, or heavy gauge galvanized steel

3 *AUTOMATIC LUBRICATION SYSTEM*

All CENTRI-SPRAY Air Washers are available with manual or automatic lubrication systems.

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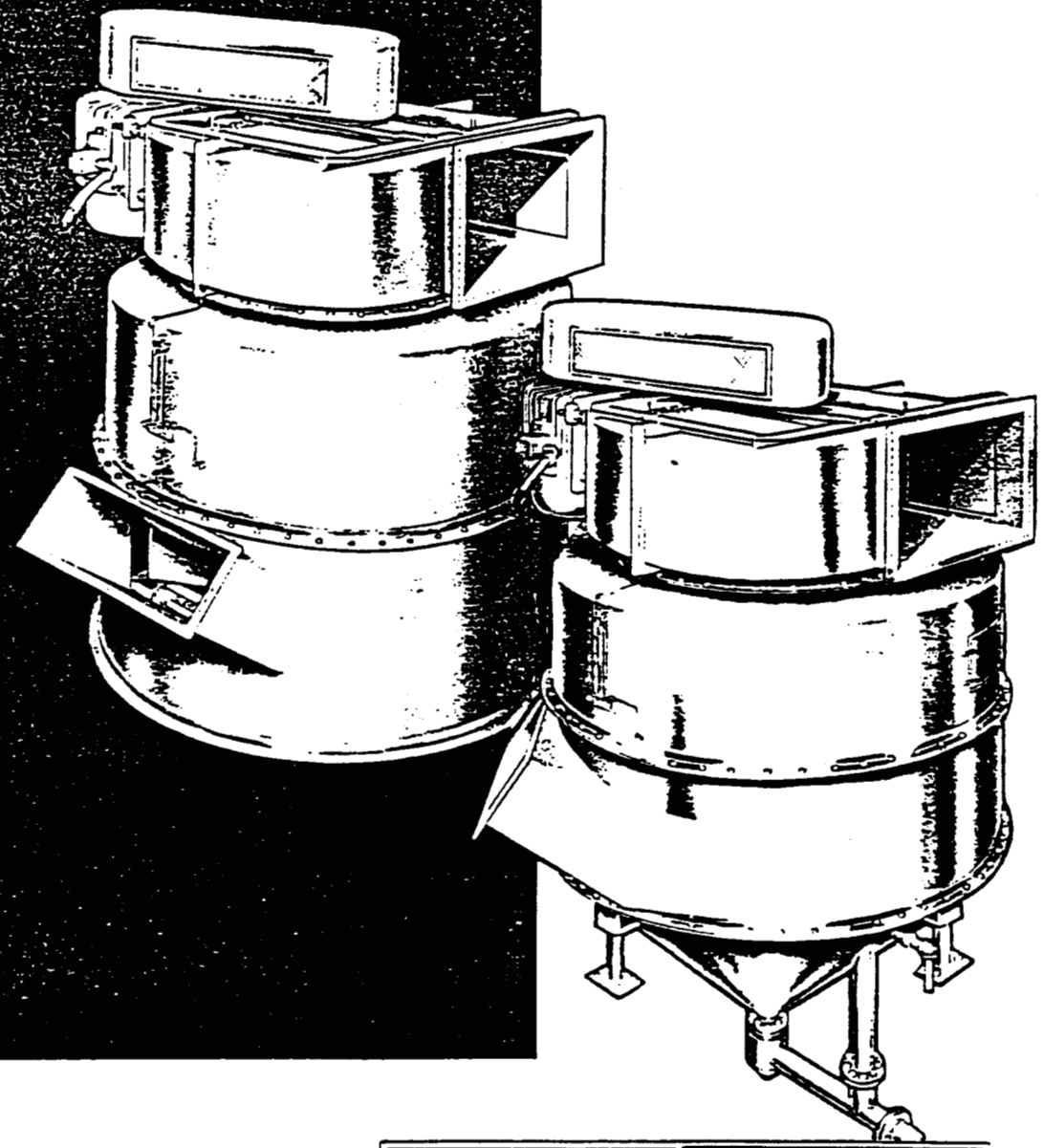
WET TYPE HIGH ENERGY

CENTRIFUGALLY GENERATED WATER SPRAY

AIR WASHERS



CENTRI-SPRAY® CORPORATION

PRINCIPLES OF OPERATION

The Centri-Spray® Wet Type Centrifugally Generated Water Spray Air Washer is a complete, self-contained air pollution control unit.

Its fan, water pump, air distributor, high kinetic energy water spray generator, and moisture eliminators, are all contained in a single housing, including the wash solution reservoir. The unit is powered by a single motor, which is mounted on the side of the fan housing, and which drives the fan, pump, and powerful water spray generator from a single shaft.

The contaminated air is drawn into the housing through a large inclined inlet. Baffles direct the contaminated air downward, across the surface of the wash solution and into the wash chamber. The contaminated air is then subjected to a uniform 360° high kinetic energy water spray. Water droplets, traveling at high speed, impinge on the dirt particulates in the air, capturing the contaminants and draining back into the reservoir.

The clean washed air continues upward through moisture eliminators, which remove airborne water droplets. Clean, droplet-free air is then exhausted through the fan housing and air ducts, back into the work area or into the atmosphere.

The Centri-Spray® Air Washer is the most efficient unit of its kind available. In many industrial applications, state boards of health have allowed Centri-Spray® washed air to be returned to the work area, from cast iron machining operations, electroplating processes, certain foundry applications and many other industrial installations.

CAPACITIES

The Centri-Spray® Air Washer is available in capacities from 4000 cfm to 42,000 cfm, in a single unit. Multiple unit installations range up to 500,000 cfm or larger, as required.

STATIC PRESSURE

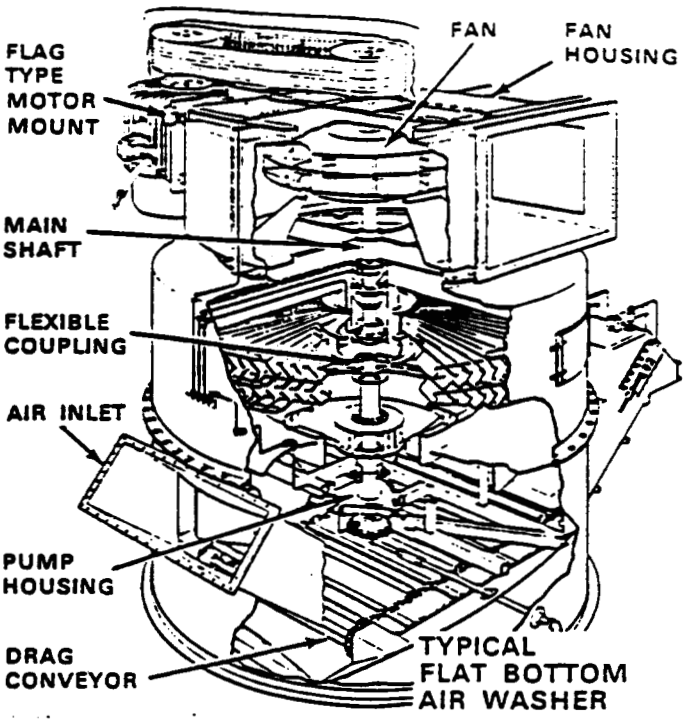
The pressure drop inside an Air Washer unit is at a minimum, varying from 2¼" standard water gauge pressure up to only 4" or 5". The high performance efficiency of these units depends on the high kinetic energy water spray, and does not require a high static pressure across the wash zone.

WATER CONSUMPTION

Water consumption in a flat bottom Air Washer, with a recirculating water system, is only that amount required to replace evaporation loss. Once the self-contained reservoir is filled, the only additional water needed is make-up water to maintain the required working level. This is controlled automatically with float actuated valves in a side tank, which is an integral part of the air washer.

POWER CONSUMPTION

The horsepower requirements of a Centri-Spray® Air Washer are determined by the cubic feet of air moved per minute; the volume of water to be sprayed; the static pressure required to move air in the total duct-work system, and the particulate removal efficiency required to meet local air pollution control regulations.

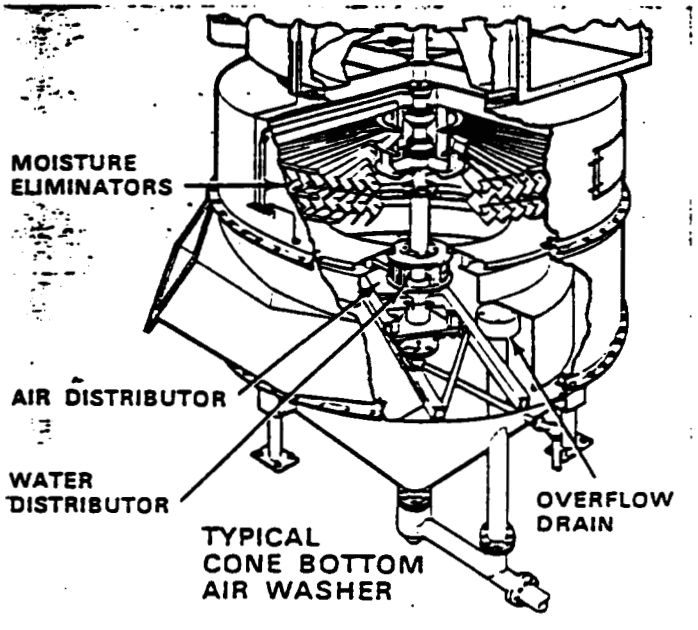


A standard small or medium sized air washer requires 5 to 6 horsepower per 1000 cubic feet of air moved. This includes the power required to drive the pump and generate the water spray. In larger units, this power requirement will vary from 3 to 5 horsepower per 1000 cfm.

However, the power requirement can, in some cases, reach 10 horsepower per 1000 cfm. This would be where a very high static pressure exists in the ducts, and where the inlet loading is unusually heavy, and when extreme efficiency is required in capturing airborne particles of micron and sub-micron size.

CONSTRUCTION MATERIALS

Normally, a Centri-Spray® Air Washer is constructed of standard carbon steel components. However, if the unit must work in a corrosive or abrasive atmosphere, the components will be constructed (at extra cost) of stainless steel, inert plastic and other corrosion or abrasive resistant materials.



FLEXIBILITY OF DESIGN

The Centri-Spray® Air Washer offers a flexibility of design, size, and application which can be matched to almost any Air Pollution Control requirement. Even after initial design and installation, these units may be easily modified to meet the demands of changing production requirements, or tightening of local air pollution control regulations.

This versatility has made it possible to apply these units to virtually every type of manufacturing process. They are currently removing airborne particulate matter in manufacturing plants all over the world.

METAL WORKING INDUSTRY APPLICATIONS

These units will effectively remove large, small and sub-micron size airborne particles of grinding dust, machining particulate, abrasives, oil mists, polishing and buffing residues, and chemical fumes from various industrial processes. In addition they offer sustained performance under continuous operating conditions.

These units are successfully removing airborne contaminants as follows:

Cast iron machining	Paint overspray
Buffing and polishing	Asbestos dust
Oil mist	Magnesium machining
Leather dust	Shot blast operations
Rubber dust	Sand
Lint	Foundry snag grinding
Fiberglass	and many others

CHEMICAL PROCESSING INDUSTRY APPLICATIONS

The Centri-Spray® Air Washer can be considered a "chemical reaction vessel." These wet type air washers have found wide-spread use in removal of airborne chemical fumes from electroplating and anodizing operations, cyanide treatment, chemical manufacture, flux fumes, resin treated fiberglass and many other sources of chemical fumes. With its closed, recirculating water system, specific chemicals can be added to the wash solution to help absorb, neutralize, and efficiently remove airborne chemically active and corrosive fumes.

The chemical reagents allow the Air Washers to simultaneously absorb or destroy airborne chemicals, as well as remove any solid particulate matter in the contaminated air.

Centri-Spray® Air Washers are currently removing airborne chemical fumes from:

Coke gas	Diesel exhaust
Chromic acid	Remelt furnace fumes
Nitric acid	Cyanide fumes
Caustic soda	Aluminum melting
Hydrochloric acid	Zinc fumes
Sulphuric acid	and many others

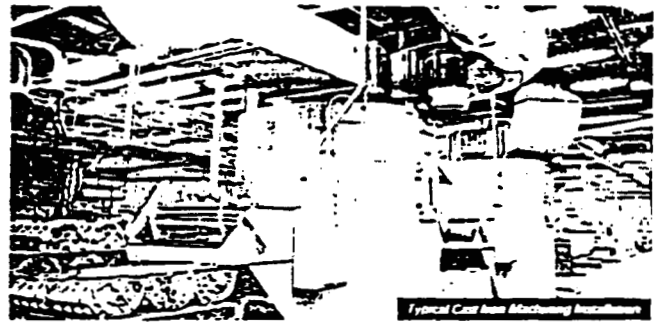
RECLAIMING VALUABLE MATERIALS

The Centri-Spray® Air Washer has been used to reclaim many valuable airborne materials.

Chemical compounds, valuable metals, plastic mold dust and other items have been reclaimed where the economics warranted their further processing.

Each Air Washer is equipped with some type of system to remove accumulated sludge, depending on customer preference. These systems are designed to remove the settled, suspended or floating contaminants that are captured. If reclaiming is practical, a drum type filter system can be installed to remove the accumulated solids in a semi-dry form, and automatically deposit this residue in containers suitable for the reclaiming process.

If the material to be reclaimed is a chemical, then select reagents can be added to the wash solution, to react and absorb the chemical into solution. Then this solution can be reprocessed to separate the valuable components.



FLAT BOTTOM STYLE

The Centri-Spray® Air Washer is made in two basic configurations: flat bottom and cone bottom. The most commonly used is the flat bottom unit with its self-contained reservoir. This style is used with both heavy and light inlet loading, for all general purpose applications. It offers the advantage of a closed, recirculating wash solution system and can be located anywhere in a manufacturing plant. It requires only connection to plant services and ductwork, or isolated dust hoods, for immediate operation. These units can be used to service one small machine or operation, and exhaust clean air back to the immediate work area, or they can be attached to existing duct systems and service many manufacturing operations.

CONE BOTTOM STYLE

A cone bottom Air Washer is also available for use where the dirt load is excessively heavy, as in foundry operations or where the unit must be exposed to below freezing temperatures. The cone bottom unit is the same as the flat bottom style in every respect, except the water reservoir is self draining at shut down. The dirty wash solution is drained to a remotely located tank or settling basin where solids are sedimented, or filtered, and removed before the wash solution is recirculated to the system. The same sustained efficiency under continuous operating conditions is built into the cone bottom style unit, as it is in the flat bottom style.

RECIRCULATING CLEAN AIR

The high efficiency of the Centri-Spray® Air Washer will allow recirculation of clean washed air back to the work area on most applications. Many State Boards of Health have tested installations where the air, washed clean by these units, was found to be cleaner than the normal air surrounding the plant.

Due to this careful testing and evaluation, clean washed air has been recirculated back to the work areas from cast iron machining operations, plating and buffing installations, sand handling and other foundry operations, and many other chemical processing or metal working installations. This allows considerable savings in heating costs during cool weather, plus helping to provide healthful ventilation.

In addition, employees work in a clean atmosphere, and general maintenance cleaning operations are held to a minimum.

ACCESSORIES:

CLEANING FACILITIES

All Centri-Spray® Air Washers are equipped with some means of removing contaminated wash solution or accumulated sludge from the wash water, depending on the type and quantity of particulate matter to be collected, as follows:

RESERVOIR DRAIN

Air Washers designed only for removal of undesirable airborne chemical fumes, oil mist or fumes from plating operations need only be provided with a drain pipe and valve, as shown, so that contaminated wash liquid can be drained from the Air Washer reservoir. This drain should be attached to suitable piping, so that strong chemical concentrations are directed to processing points for neutralization or removal of harmful chemical components before draining to sanitary sewer systems.

Air Washer installations where the dirt load is light and composed of material that will easily settle to the bottom of the Air Washer, need only be provided with a hand clean out tank, as shown in Figure F.

DRUM FILTER

Air Washers designed to collect heavy or light loads of fine airborne dust or dirt particles, such as grinding dust from metal, rubber, leather, plastic, etc. or other fine particles of material that would remain in suspension in the wash solution, should have a drum type liquid filter as an integral part of the unit.

The permanent media drum type filter will remove suspended solids from the wash solution, and deposit them into a container for disposal or reclaiming. The drum filter is ideally suited for reclaiming valuable materials, as the accumlated sludge is deposited in a semi-dry condition into a gondola or other container for easy handling.

DRAG CONVEYOR

The most commonly used method of removing accumulated solids from the wash solution is the Drag Conveyor. This unit can be built as an integral part of the Air Washer and will automatically remove all heavy settled particles collected, and deposit them into a container for disposal or reclaiming.

AUTOMATIC LUBRICATION SYSTEM

All Centri-Spray® Air Washers are available with hand type lubrication systems for the motor, fan, pump and distributor shaft bearings. As this type of system is dependent on human responsibilities for adequate lubrication procedures, it is also subject to human frailties and possible errors. Therefore, it is recommended that each Air Washer be equipped with an automatic lubrication system.

FIG. E

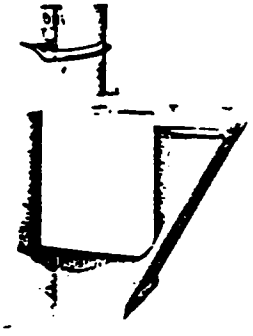


FIG. F

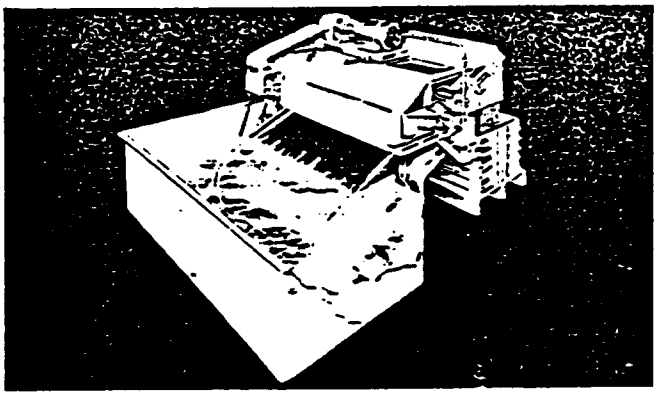


FIG. G Air Washer Drum Filter

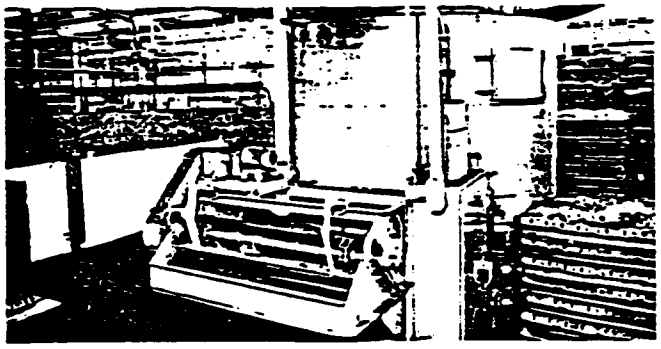


FIG. H Air Washer with Integral Drag Conveyor

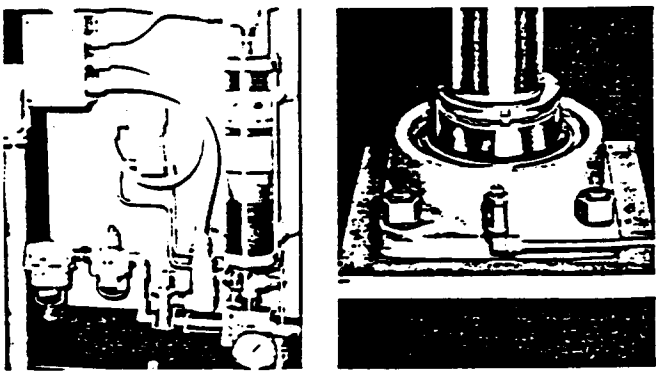


FIG. I Automatic Lubrication System with Pressure Relief Valves

WATER DISTRIBUTOR BEARINGS

Centri-Spray® Air Washers are available with two types of bottom water distributor bearings. The sealed ball type bearing, Figure J, and the Oilite sleeve type bearing, Figure K. Both bearings offer certain advantages depending on application of the Air Washer.

For all normal duty applications, the Oilite sleeve bearing is recommended. This bearing is an integral part of the pump housing assembly, is less expensive, easy to maintain, and has proven its durability in thousands of applications.

The sealed ball type bearing is recommended where excessively heavy dirt loads are encountered, such as in foundry installations, or any similar application where a large amount of coarse material would be present in the air to be washed.

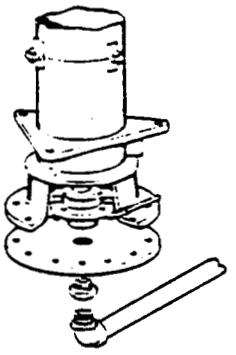


FIG. J

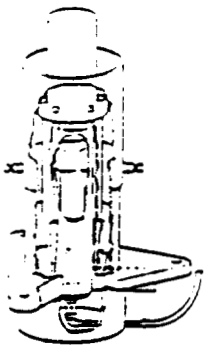


FIG. K

WATER DISTRIBUTOR

Two different types of water distributors are available, each with certain performance qualities required to efficiently handle specific soils.

Figure L is the bar type water distributor, intended for general purpose applications. If excessive amounts of corrosive materials will be encountered, this unit can be constructed of exotic metals to resist the corrosive effect of the liquid. Also, if the airborne particulate is very abrasive, the bar type water distributor can be coated with Urethane or other abrasive resistant material.

Figure M illustrates the "Vane" type water distributor, which has been designed for effective application on stringy, sticky type particulate matter, such as the residue from buffing and polishing operations.

The type of water distributor required for each installation must be carefully engineered to provide optimum performance and durability. Therefore, it is essential that the actual materials present in the contaminated air be determined accurately, before design and construction of each Air Washer.

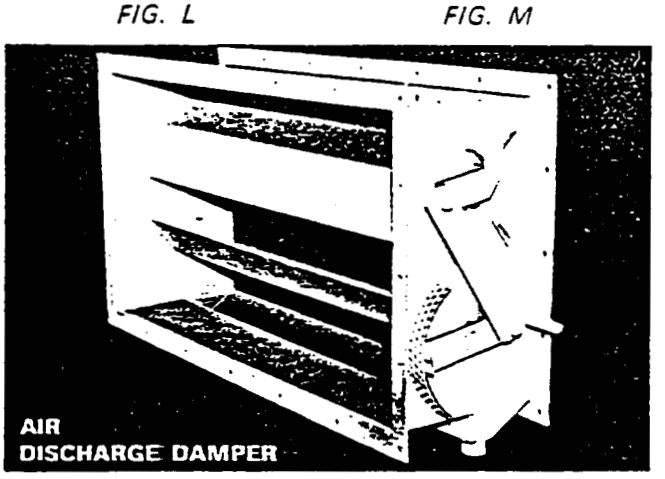


FIG. L

FIG. M

AIR DISCHARGE DAMPER

Installations where existing ductwork does not incorporate an adequate air damper control, it is recommended that an Air Discharge Damper (Fig. N) be included with each Air Washer. This is essential to maintain static pressure in the unit and maintain operating efficiency.

FIG. N

MOISTURE ELIMINATORS

Moisture eliminator sets used in the Air Washer can be made from high molecular weight polypropylene, as shown in Figure O, or heavy gauge galvanized steel (Figure P).

These rigid, heat treated plastic units are light weight, shock resistant, require no metal fasteners to maintain shape and are easier to clean. They require only periodic washing with cold or warm water to remove any accumulated dust or dirt.

The galvanized metal moisture eliminators are less expensive and perform equally well under most circumstances. However, they are heavier and must be removed from the housing for periodic cleaning. Also, it is sometimes necessary to use a steam cleaner to remove accumulated deposits of dust and dirt.

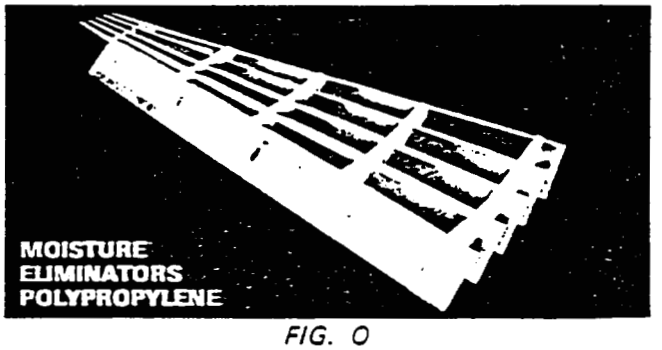


FIG. O

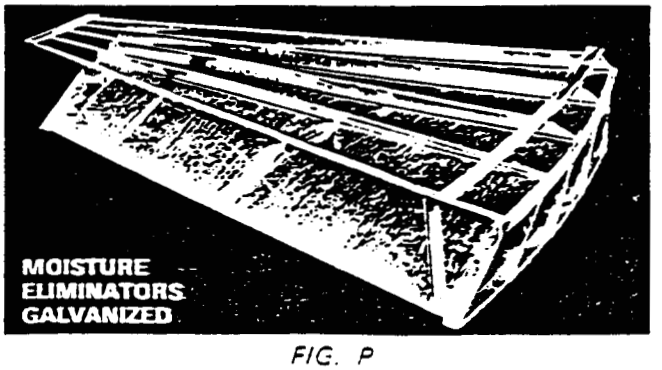
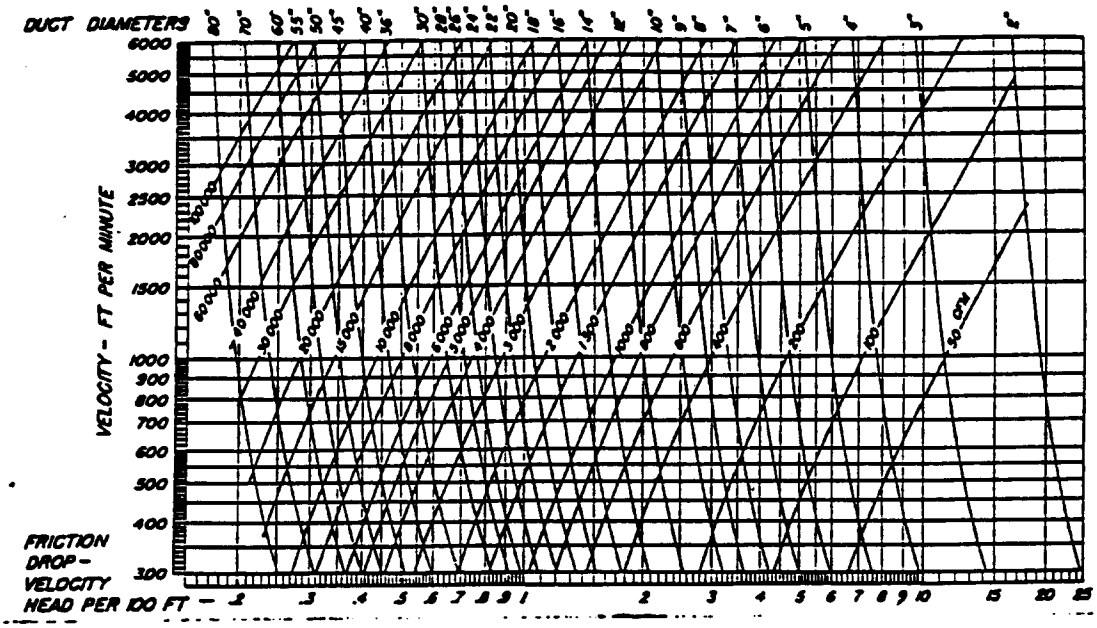


FIG. P

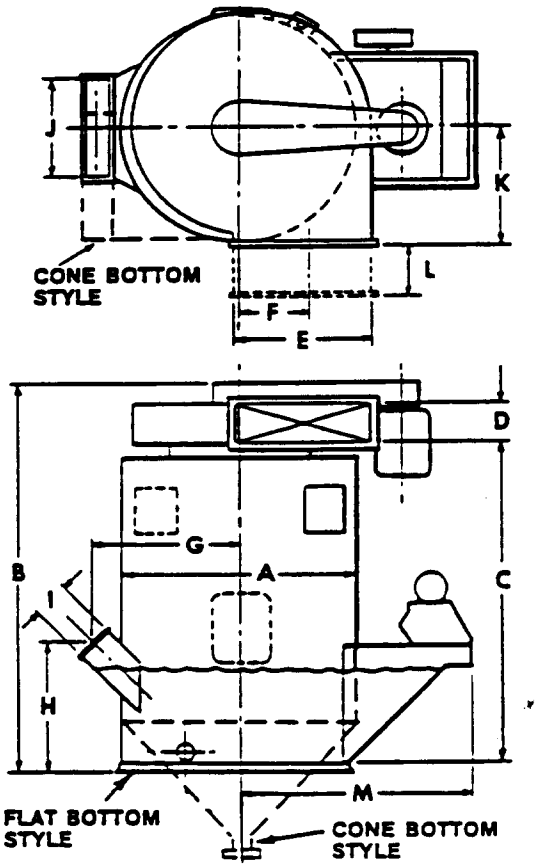
GENERAL SPECIFICATIONS

Many design features, standard on Centri-Spray® Air Washers, are not found even at extra cost on competitive units. These features reduce maintenance costs, and extend the expected life of the Air Washer.

1. Each Centri-Spray® Air Washer is equipped with a "flag type" motor mount, which allows simple adjustment of belt tension, prolongs life of belts, and eliminates efficiency loss from slippage.
2. The bottom of all Centri-Spray® Air Washers is supported *off the floor* with a built-in grid of angle supports which prevents bottom rusting.
3. All Centri-Spray® Drag Conveyors provide adjustment for chain tension, to assure that drag flights efficiently remove accumulated sludge.



For your convenience in estimating duct system requirements, you may use the nomograph shown above. This graph, along with the dimensional chart showing Air Washer capacity and physical size, will help you determine approximate sizes and values for most average Air Washer systems. A more detailed analysis must be made, to identify airborne particulate matter to be removed, before an efficient system can be designed.



	CAPACITY IN C.F.M.					
	5,000	10,000	15,000	20,000	25,000	30,000
A	4'-2"	6'-0"	7'-3"	8'-4"	9'-0"	10'-0"
B	8'-6½"	11'-4"	11'-10"	13'-0"	13'-3"	13'-6"
C	6'-8½"	8'-5½"	9'-0"	9'-10½"	10'-1"	10'-4"
D	10"	18"	20"	24"	24"	24"
E	30"	38"	38"	45"	5'-6"	5'-6"
F	13½"	15¾"	18¾"	20¾"	29¾"	29¾"
G	33"	45½"	4'-9¾"	5'-2"	5'-6"	6'-1"
H	43¾"	4'-6"	4'-8"	5'-0"	5'-0"	5'-1"
I	9"	14"	18"	20"	20"	22"
J	24"	36"	40"	4'-0"	5'-0"	5'-6"
K	28"	32"	32"	38"	40¾"	42"
L	11"	12"	12"	12"	12"	12"
M	7'-6"	8'-1¾"	8'-4¾"	9'-5"	9'-10"	11'-6"

Write or call today, and a Centri-Spray® sales engineer will work with you to determine the kind of system you will require to meet your local air pollution control regulations.

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Reducing solvent emissions from vapor degreasers

FACT SHEET

The following information identifies the numerous factors affecting solvent emissions, and provides detailed information on how to reduce these emissions. In individual degreasing operations, these factors are likely to vary significantly in importance.

Emissions Due to Drag-Out

Reduction techniques	Estimated % Reduction
(1) **Withdraw parts from the degreaser when they stop dripping.** Withdrawing moist parts from the vapor zone results in a 60% reduction in solvent emissions compared to withdrawing dripping parts. Parts should be left in the vapor zone (below the cooling coils) at least until no drops are visible on the parts.	60%
Note: Parts that are wet and dripping usually indicate that the temperature of the parts is considerably less than the vapor temperature. When this occurs, the rinsing effect of the vapor degreaser may not be fully utilized and the parts may remain dirty. Rinsing (vapor degreasing) may not be necessary in this application.	
(2) **Hold parts in the freeboard zone until all parts are completely dry.** Holding parts for a short time just above the cooling coils in the freeboard zone can result in 40% less emissions than if the parts are immediately withdrawn from the vapor zone. When removing parts from the degreaser, hold parts in the vapor zone (below the cooling coils) at least until all dripping from the parts stops (one to two minutes, for smaller parts). Then leave parts in the freeboard zone until all parts are completely dry. If time allows, lengthen the hold time in the vapor zone.	40%
Note: During the vapor zone hold, vapors condense on the cold part, completely coating it in liquid. As the part warms up and approaches the vapor temperature, liquid will drip off the part faster than it recondenses. Some liquid will remain on the part until it reaches the vapor temperature, which will take a long time. Therefore, for all practical purposes residual liquid will remain when parts are removed from vapor. If parts are taken immediately	

(continued)

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Estimated
% Reduction

out of the degreaser this residual liquid will quickly evaporate into the unsaturated air and be lost. If there is a hold in the freeboard zone, the residual liquid will still evaporate quickly into the unsaturated air, but since the solvent vapor is heavier than air and is still directly above the unit, much of the vapor will fall back into the vapor zone and be recaptured.

The best way to control drag-out emissions is through the use of a programmable transport system, since even with excellent training on the need and methods for controlling emissions, it is physically difficult, if not impossible, for a person to hold heavy parts away from their bodies for any length of time. If programmable transport systems cannot be justified, set up a stand for hanging parts or baskets at appropriate levels, and provide timers to keep the hold time above the minimum required for your application.

(3) **Use parts holding fixtures that promote better drainage.** unknown
The effect of using better fixtures for holding parts (racks or baskets) was not measured. Position parts so draining is promoted and liquid hold- up is minimized. Minimize the surface area, the weight, and the heat capacity of the fixture or basket to reduce drag-out caused by the parts holder. Consider using a rotating basket to drain complex parts.

Emissions Due to Diffusion

Reduction techniques

(1) **Add freeboard height to degreasers.** Degreasers with 75% freeboard will have about 30% less solvent emissions than degreasers with 45% freeboard when both are idling and open. Degreasers with 100% freeboard will have about 15% less solvent emissions when idling than ones with 75% freeboard. 15-30%

$$\% \text{ freeboard} = \frac{\text{(top of the cooling coils to the lip distance) x 100}}{\text{width (shorter dimension) of the degreaser mouth}}$$

(2) **Keep an idling degreaser covered.** A covered, idling degreaser will have about 15% less emissions than an uncovered degreaser. 15%

Note: Drafts or inadequate freeboard or chiller capacity would greatly increase the value of covers.

(3) **Reduce vapor displacement.** The effect on emissions caused by high volume parts displacing vapors above the cooling coils was not measured. Try slower hoist speeds or the stop-and-go technique to unknown

(continued)

Estimated
% Reduction

correct a displacement problem. A withdrawal speed of less than 10 feet-per-minute (fpm) may be required for large loads.

Note: Both of the above techniques allow the condenser coils to cool the vapor before it is lost. Vapor displacement works on the same principle that causes the level of water in a tub to rise when a solid object is placed in that tub. Vapors above the coils are more likely to diffuse out as they warm up, and they are more likely to be carried out by drafts or by parts being withdrawn.

Emissions Due to External Drafts

Reduction techniques

(1) **Avoid using lip vents, or keep vents turned off.** A degreaser without lip vents (or vents turned off) will have 15% less solvent emission than a degreaser with a vent. — 15%

Note: Odors or high concentrations of solvent in the workplace generally come from liquid solvent dragged out on parts, splashed out by sprays, or leaked from external fittings. The lip vent will never capture these emissions. First, correct your procedures, and then use a lip vent only if additional protection for workers is needed. Or use a lip vent in conjunction with a scrubber to limit emissions from your building. Then, if possible, compensate for the higher vapor losses by adding freeboard to your degreaser.

(2) **Eliminate external drafts around the degreaser.** The effect on solvent emissions from a degreaser after eliminating external drafts from fans and ventilators (possibly the chiller fan), compared to a degreaser exposed to drafts, was not measured. — unknown

Note: The effect will depend primarily on the speed and direction of the draft. Use the lip vent estimate described above as a point of comparison. To reduce or eliminate drafts, redirect air away from degreasers, consider placing baffles around the degreaser or between the degreaser and the draft source, or eliminate the source of drafts.

Emissions Due to Internal Drafts

Reduction techniques

(1) **Slow the speed at which parts are moved.** Parts moved through the vapor zone at speeds of 10 fpm vertically will have emissions that are 30% less than parts moved at 20 fpm. — 30%

(continued)

		Estimated % Reduction
	Note: Manual moving of parts is typically in the 30-100 fpm range. If parts with large cross-sections are moved between sumps in a more sophisticated degreaser, horizontal speeds may be important also to avoid drafts. Slower speeds are recommended for very heavy loads to avoid vapor collapse.	
(2)	**Keep large cross-sections of parts 50% smaller than the corresponding degreaser section.** The effect of emissions of parts with very large cross-sections in the direction of movement through the vapor zone was not measured. As a rule keep the cross-sectional areas of parts less than 50% of the corresponding degreaser section.	unknown
(3)	**Sliding covers may reduce drafts and turbulence.** The effect of using a sliding cover compared with using a hinged, or lifting cover was not measured. Each time a hinged cover is opened, induced drafts and turbulence will carry out some vapor. The magnitude will depend primarily on how often the degreaser is uncovered and how fast air moves above the degreaser. If lip vents are used, place the sliding cover between the vent and the vapor.	unknown

Emissions Due to the Use of Sprays

Reduction techniques		Estimated % Reduction
(1)	**Minimize the use of sprays, and keep sprays at temperatures near the boiling point.** Not using solvent sprays inside a degreaser will result in 30-50% less solvent emissions than if sprays are used. Minimize spray use and assure that spray temperatures are near the solvent boiling point — avoid cold sprays in a vapor degreaser. *Note: Use of sprays may indicate that either the solvent or the vapor degreasing operation is inadequate for your cleaning task — review your options. Sprays increase emissions by inducing drafts inside the degreaser, and the spray stream itself will carry air or vapor along with it. Cool or cold spray will condense vapors, thereby collapsing the vapor blanket and sucking air below the cooling coils. At a minimum, this air will carry some vapor out with it as the vapor blanket is reestablished and pushes the air out. (Note - as long as the vapor blanket is collapsed, the unit is not functioning as a vapor degreaser). Careless spraying can result in liquid solvent being splattered out of the degreaser entirely.*	30-50%
(2)	**Keep the spray nozzle below the cooling coils.** Holding the spray nozzle below the cooling coils will result in 30% less emissions than if the nozzle is kept above the vapor blanket.	30%

(continued)

		Estimated % Reduction
	Consider positioning the spray nozzle permanently below the coils and manipulate the part for cleaning. *Note: Drafts that are above the cooling coils in the degreaser are more likely to carry vapors out of the unit entirely.*	
(3)	**Use short spray bursts.** Keeping spray bursts short will result in 15% less solvent emissions than spraying for intervals longer than 10 seconds. *Note: Long bursts of spray induce larger drafts and are more likely to collapse the vapor blanket.*	15%

Reducing Solvent Emissions by Purchasing New Equipment

Reduction techniques

(1)	**Superheat the vapor.** Raising the vapor temperature above its normal boiling point (superheating) will reduce emissions by 90% compared with having the vapor temperature at the solvent's boiling point. *Note: The elevated temperature allows parts to dry in the vapor zone completely and quickly. In a standard degreaser design, parts remain wet with solvent as long as they remain in the vapor zone. Drying reduces or eliminates the need for a freeboard hold. The superheated vapor temperature would typically be 150% of the normal boiling point. Retrofitting an existing degreaser with superheated vapor may be possible in some cases.*	90%
(2)	**Install freeboard cooling coils.** Adding freeboard cooling coils (0°F) near the top of the degreaser will reduce idling losses by 15%. *Note: Freeboard coils are a second set of coiling coils placed in the freeboard zone, and are usually refrigerated. Freeboard coils decrease diffusion by keeping vapors cold and heavy; heavy vapors are less susceptible to drafts. However, these coils add cost and dehumidify air in the freeboard zone. This additional water can overwhelm standard water separators, which can lead to solvent acidification, equipment damage, and high waste disposal costs. Make sure your water separator is adequate for the task, or better provide a second, large, water separator for the Freeboard coils.*	15%
(3)	**Install secondary condenser coils.** For HCFC's (modelled using CFC-11 [a refrigerant]), adding secondary coils (0°F) just above the primary condenser coil (45°F) reduces CFC-11 idling losses by 70%.	70%

(continued)

	Estimated % Reduction
(4) **Install a third coil for dehumidification.** Adding a third, dehumidification coil (0°F) near the degreaser lip reduces CFC-11 idling losses by an additional 80%.	80%

Note: DuPont (Ramsey, 1991) recently recommended a three coil system to control idling emissions from the new HCFC's. A main coil (T=50°F) condenses most solvent. A second coil (0°F) overlaps or is slightly above the main coil and captures additional solvent. A third coil located near the lip of the unit dehumidifies the air, which prevents ice build-up on the secondary coil.

From this it can be inferred that for higher boiling halogenated solvents (e.g., CFC-113 or trichloroethane), the best coil configuration would be a dehumidification coil operating at the same temperature (0°F) as the main condenser coil to eliminate internal convection currents.

The information in this fact sheet is based on tests run by Branson, Inc. of Danbury, Connecticut, and E.I. DuPont De Nemours and Company of Willmington, Delaware, as well as tests compiled by the U.S. EPA. Branson directly measured solvent loss under various conditions intended to simulate typical industrial situations. Tests were run on both CFC-113 and 1,1,1-trichloroethane. DuPont tests to measure idling losses were run using CFC-11 as a surrogate for HCFC 123.

Manufacturers of vapor degreasers and solvent are a good source of advice on emission reduction. The manufacturer of your equipment may be able to provide assistance in reducing the emissions from your specific unit.

References

U.S. Environmental Pollution Control Agency. 1989. *Alternative Control Technology Document - Halogenated Solvent Cleaners.* U.S. EPA, EPA-450/3-89-030.

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Branson Ultrasonics Corporation. 1989. *Solvent Emissions Control: A Technical Guide.* Internal publication of Branson Ultrasonics Corporation, Danbury, CT.

Branson Ultrasonics Corporation. 1989. *Solvent Emissions Audit.* Internal publication of Branson Ultrasonics Corporation, Danbury, CT.

MINNESOTA TECHNICAL ASSISTANCE PROGRAM

Checklists for identifying waste reduction opportunities

Waste reduction is receiving increasing attention as an alternative to waste disposal. Waste reduction will not only reduce your disposal costs, it also can reduce your long term liability and raw materials costs, and improve the public image of your company. Waste reduction can be achieved in a number of ways including improved housekeeping, more efficient processing equipment, waste segregation, reusing/recycling spent materials, and product changes.

The attached checklists are designed to assist you in evaluating your waste streams and identifying waste reduction opportunities to evaluate for your shop. MnTAP recognizes that each company's operations are unique but these checklists may help identify some waste reduction possibilities. The checklists cover the following areas:

1. Operating procedures
2. Cleaning
3. Machining
4. Plating/metal finishing
5. Coating/painting
6. Formulating

MnTAP staff are available to answer your questions over the phone or on-site once you have completed the checklists. This will help ensure the most effective assistance. MnTAP has also gathered vendor and technical information for many of the options listed which can be useful in assessing your opportunities. In addition, lists of vendors who provide recycling services on a contract basis are available from MnTAP if it is not feasible to implement the options listed on the checklists. Please contact MnTAP with any questions you may have at (612) 627-4646 or toll free (in Minnesota only) at (800) 247-0015.

If you know of any options that are not listed but would be beneficial to list, or if have comments about the checklists in general please feel free to call. We need feedback on how we can improve our services to better assist Minnesota businesses with waste reduction.

Acknowledgement

MnTAP wishes to thank and acknowledge the Pennsylvania Technical Assistance Program, the North Carolina Pollution Prevention Pays Program, and Jacobs Engineering for their contributions in the initial research for these checklists.

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MINNESOTA TECHNICAL ASSISTANCE PROGRAM

Minnesota Technical Assistance Program
Generator Checklists for Identifying Waste Reduction Opportunities

Telephone Numbers:
(612) 627-4555
In MN, (800) 247-0015

1) Operating Procedures

Waste Reduction Option	Yes	No	N/A	Tried in Past	Further Evaluation Required	Comments
Waste Management Policies: Does your company follow established waste management procedures and provide the necessary employee training?						
Are personnel trained routinely on company's waste management and equipment procedures?						
Is responsibility for each aspect of waste management (i.e. labeling, consolidation) clearly designated?						
Are personnel trained to recognize the impact process decisions have on waste streams in addition to the product?						
Does your company have a program to make personnel aware of waste management and waste reduction goals?						
Does your company have a program which allows personnel to suggest process changes which would reduce waste generation and recognize them for their ideas?						
Does your company segregate its raw materials from its waste materials?						
Are different waste streams segregated (i.e. oils, solvents, paints)?						
Does your company return empty containers to your supplier?						

Continued On Back

Waste Reduction Option	Yes	No	N/A	Tried in Past	Further Evaluation Required	Comments
Material Handling:						
If containers are not returned to the supplier, does your company purchase material in recycable or reconditionable containers?						
Are all containers at your facility labeled properly and clearly?						
Are all process tanks at your facility labeled?						
Does your company follow an inventory control plan to avoid wasting raw material?						
Are losses to spoiled batchs, out of date stock, spills and unused formulations periodically evaluated?						
Are pilot studies of processes performed to help determine process efficiency?						
Leaks and Spills:						
Does your company capture and reclaim spilled or leaked material?						
Are oil absorbent pads which can be reclaimed using a wringing device used in place of granulated kitty litter type material?						
Have splash guards or drip boards been placed on tanks or around operations which splash?						
Has your company installed spill basins or dikes in storage areas?						
Have overflow control devices been placed on process tanks?						
Does your company routinely inspect and perform necessary maintenance on piping joints and pumps?						

If you have any questions regarding the options listed or require additional information, please call MnTAP at (612) 627-4555 or in Minnesota at (800) 247-0015.

MINNESOTA TECHNICAL ASSISTANCE PROGRAM

Minnesota Technical Assistance Program
Generator Checklists for Identifying Waste Reduction Opportunities

Telephone Numbers:
(612) 627-4555
In MN, (800) 247-0015

2) CLEANING

Waste Reduction Option	Yes	No	N/A	Tried in Past	Further Evaluation Required	Comments
Solvent Cleaning General: Are your cleaning units installed and operated as per manufacturer's instructions?						
Are cleaning needs and the efficiency of the cleaning system routinely evaluated?						
Is the loss of the solvent's cleaning ability monitored prior to replacing the solvent?						
Is cross-contamination of the solvents avoided?						
Is water contamination of the solvent avoided?						
Is sludge from the cleaning tanks removed on a routine basis?						
Has your company investigated the use of an on-site distillation unit for solvent recovery and reuse?						
Has your company investigated the use of aqueous based cleaning as an alternative to solvent cleaning?						
Has your company considered using non-chlorinated solvents in place of chlorinated solvents where possible (note non-chlorinated solvents can be more flammable than chlorinated solvents)?						
Has your company investigated using plastic media blasting or a water based material for paint stripping in place of a solvent based stripper?						

Continued On Back

Waste Reduction Option	Yes	No	N/A	Tried in Past	Further Evaluation Required	Comments
Solvent Cleaning Vapor Degreasers: Do your employees cover all cleaning tanks when they are not in use to prevent vapor loss (note units should be covered with a material impervious to the solvent vapors)?						
Do your degreasers contain a refrigerated freeboard which will condense the solvent vapors within the unit and return the condensate to the bottom of the tank?						
Are the degreasing units placed in an area of the shop where drafts will not enter them and push out vapors?						
Has your company considered adding cooling jackets to the outside walls of the degreasing units in conjunction with the interior cooling coils to prevent vapors from escaping along the unit's wall?						
Are parts or racks placed in the degreaser in a way in which excessive amounts of vapors are pushed out of the unit?						
Is work removal rate set at a speed low enough to prevent vapor dragout?						
Solvent Cold Cleaning: Has your company considered centralizing and consolidating cold cleaning operations to minimize vapor losses?						
Are you using counter current cleaning methods where possible (i.e. using dirty solvent for initial cleaning and clean solvent for final cleaning)?						
Are parts allowed to hang above tanks for solutions to drain back into the tanks and reduce dragout?						

Continued On Next Page

Cleaning Continued:

Waste Reduction Option	Yes	No	N/A	Tried in Past	Further Evaluation Required	Comments
Alkaline/Acid Cleaning: Are cleaning units installed and operated as per manufacturer's instructions?						
Has your company considered increasing drain times for parts before/after washing to reduce dragout?						
Do personnel avoid cross-contaminating the cleaners?						
Are dropped parts removed from the cleaning tank on a routine basis?						
Is sludge from the cleaning tank removed on a routine basis?						
Has your company considered reusing cleaners by filtering and rejuvenating them?						

If you have any questions regarding the options listed or require additional information, please call MnTAP at (612) 627-4555 or in Minnesota at (800) 247-0015.

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Summary

1989 Summer Intern Report

by Pat Buresh

REDUCTION OF SOLVENT EMISSIONS FROM VAPOR DEGREASERS

Hutchinson Technology, Inc. (HTI) implemented a number of low cost, low technology procedures to reduce emissions and prevent solvent loss from two open-top freon (CFC-113) vapor degreasers (Branson #1 and #2). HTI is a computer components manufacturer that uses freon vapor degreasing systems to remove fluxes and other residues remaining on the flexible printed circuits from the soldering process. With relatively minor changes in operation, solvent emissions from the two degreasers were reduced by approximately 35 percent.

The waste survey conducted at HTI on the vapor degreasers indicated that an average of 6.1 GPD freon was lost from Branson #1 and an average of 2.1 GPD from Branson #2. Proper operation of a number of factors was confirmed such as proper freeboard ratio (100%), and the operation of freeboard chillers, with satisfactory cooling water temperature. Options for reducing emissions from each degreaser were addressed separately.

Branson #1 is used primarily to remove fluxes and other residue left on the parts by the soldering process. It is a two sump vapor degreaser with a solvent capacity of 75 gallons, equipped with a programmable transport and a solvent recovery still. At the time of this project, 50% of the cleaning operations with this unit were done with an automated transport system.

Measures taken to reduce emissions from this vapor degreaser included:

- o reprogramming the transport so that more cleaning operations could take advantage of its use,
- o turning off the lip vent, and
- o replacing the rack protective coating with a non-absorbent material.

While attempts were made to document the effect of each change by repeated daily readings of solvent level in the still, this could not be done conclusively. The one change that appeared easiest to document was of the approximately a 25% emissions reduction by turning off the lip vent. By the end of this project the total emissions for this unit had dropped by an average 2.4 gallons per day or approximately 40 percent.

Branson #2 is also open-top two-sump vapor degreaser with a solvent capacity of 42 gallons. It did not have a still or a transport system. The manual cleaning cycle consisted of a vapor rinse, three minutes in the ultrasonic bath and then air drying in the freeboard area.

The one measure taken to reduce emissions was to make a simple stainless steel rack that provided places to hang parts in the vapor zone, as well as the freeboard area. Previously, parts were only held in the freeboard area. This change resulted in an estimated 20% reduction in emissions.

In addition to the reductions obtained by relatively minor changes in operation, it should be emphasized that checking for leaks or closely examining losses during maintenance and solvent changes may also provide easy opportunities for reducing emissions. It was noted during the project that freon was lost every time filter cartridges or desiccant were changed.

A conclusion of this project is that small changes in the operation of a vapor degreasing unit provide possibilities for significant reduction in solvent emissions. However, the changes in day-to-day operations may make it difficult to document the effect on a given change in the emission level.

Patrick Buresh is completing a mechanical engineering program at Washington University, St. Louis, MO

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1990 Intern Report Summary

Reducing Chlorinated Solvent Emissions from Three Vapor Degreasers

– by Corey Hymes, MnTAP Intern

Alliant Techsystems manufactures aluminum and steel components for armaments, under defense contract, in Arden Hills, Minnesota. As part of the manufacturing process, six vapor degreasers are used to remove oil and other soils from the components. The focus of this study was to identify the causes of solvent loss from three of the degreasers, and suggest options for reducing those losses.

Two of the degreasers studied were of the in-line type using Trichloroethylene as solvent. Solvent loss was measured over a two month period and found to be 3,510 gallons per year for both degreasers. Causes of the solvent loss were:

- Drafts from the lip vents.
- Drafts from nearby cooling fans.
- A heat imbalance in the sumps.
- Thermal shock from parts handling.
- Leaks.

Changes in operating procedures and maintenance for these degreasers were identified and the reduction of solvent loss estimated at 40%. This represented a savings in raw material purchases of $4,800 per year.

The third degreaser was of the open-top type using 1,1,1,Trichloroethane as solvent. Solvent loss was measured over a two-month period and found to be 3,690 gallons per year. Causes of the solvent loss were:

- The speed of the cleaning cycle.
- The hoist velocity.
- Mass of the load being cleaned.
- A malfunctioning water separator.
- Lip vents and an unused cover.

Changes in operating procedures and maintenance for this degreaser were identified and the reduction of solvent loss estimated at 50% - 80%. This represented a savings of $6,700 - $11,000 per year.

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Evaluation of Aqueous Cleaners to Replace TCA Degreasing

INTERN PROJECT SUMMARY

Intern project date: Summer 1991
Intern: Bill Butler
Company: Continental Machines, Inc., Savage, Minnesota
Project Supervisor: Bob Lundquist, MnTAP

Process Background

Continental Machines, Inc. (CMI) manufactures a wide variety of hydraulic pumps. The manufacturing process involves various machining steps on metal parts including turning, drilling, tapping, deburring, grinding, broaching, screw machining, welding, and lapping. These processes require a variety of machining fluids such as water soluble machining oils, cutting oils, rust inhibitors, and lapping compounds. To remove these fluids, as well as particulate matter such as dust and soils, CMI dipped machined parts in room temperature 1,1,1-trichloroethane (TCA) contained in 5 gallon buckets and 35 to 50 gallon tanks. Dipping time ranged from a few seconds to a few minutes depending on: 1) the contaminant being removed, 2) the cleanliness required for the next production step, and 3) the time lag from the dipping operation to the next production step. Parts cleanliness was measured either by a visual check or a functional test.

In 1990, CMI used 86,000 pounds (lbs.) of TCA of which 52,000 lbs. were lost to air evaporation and 34,000 lbs. of spent or dirty TCA were sent to a treatment facility. CMI formed an employee investigative group, the Chlorinated Solvent Reduction Team, to gather and discuss waste reduction information including substitutes for TCA. The intern project assisted the team by performing benchtop tests of many aqueous alternatives to TCA, and by implementing and monitoring the use of the two most promising aqueous cleaners in selected production areas.

Incentives for Change

The primary incentive for CMI to change from TCA to an aqueous cleaner was to avoid the high cost of purchasing and disposing of TCA. CMI was also concerned that the 1990 Clean Air Act may, in the near future, impose a TCA emissions tax.

Intern Activities

The intern evaluated 31 different aqueous cleaners manufactured by 17 companies. Criteria used to evaluate and compare the cleaners included:

- Time required to clean the part when soaked in room temperature cleaner.
- Rinsing requirements
- Drying time and method (air dry or compressed air)
- Formation of rust

(continued)

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The two most promising cleaners were used in production for further evaluation under actual manufacturing conditions. The intern worked with equipment operators in 7 of the 10 process steps to help familiarize them with the best use of aqueous cleaners in order to obtain optimal results.

Results

The two most significant results of the evaluation are:

1. Aqueous cleaners removed contamination at least as well as TCA.
2. Aqueous cleaners can replace TCA in 5 of the 10 process steps. Two of the remaining steps have substituted mineral spirits for TCA.

A machining process can include many different operations, machining fluids, and cleanliness requirements. Therefore, when using aqueous cleaners, modifications in the cleaning process will be needed to meet quality and production standards. These include:

- Changing the temperature of the aqueous cleaner
- Changing the temperature of the rinse water
- Modifying the rinsing process
- Using a different drying method: air dry or compressed air
- Using a rust inhibitor

For example, at CMI, a 35 gallon tank of TCA at the deburring pre-wash station was replaced with an aqueous cleaner at room temperature. The operator was very pleased with the results and the cleaner lasted much longer than the TCA. The parts did not need rinsing since the cleaner was compatible with the chemical used in the deburrer.

Of the two cleaners evaluated under actual cleaning conditions, both had an alkaline base, but one was emulsifying and the other nonemulsifying. The emulsifying cleaner was determined to have a high loading capacity and was capable of cleaning heavily soiled parts. This cleaner is now being used by most operators. The nonemulsifying cleaner caused the oil to separate and float to the surface. Consequently, this cleaner is used only in areas where the contamination is light and cleanliness is not critical.

The general problem experienced at CMI with the aqueous cleaners was longer processing times, usually requiring at least one minute to complete the job. This was apparent when operators had to wait for parts being cleaned for inspection purposes (to determine if the machining was producing good parts). Complex parts usually had to be manually dried with compressed air to prevent rust.

Although not addressed by this project, another concern about the use of aqueous cleaners is disposal requirements. Spent aqueous cleaners must be treated prior to disposal to comply with sewer regulations. Treatment may involve the use of evaporators, oil skimmers, filters, neutralization, or de-emulsifying equipment.

However, in spite of these concerns, CMI is expecting to replace TCA with the aqueous cleaners. The net savings that would result from this change (about $83,000 annually) and the comparable or improved cleaning results from the aqueous cleaners makes this alternative look very promising. Note: The savings include projected equipment purchases that will enable all workstations to use aqueous cleaners.

Cost Analysis
1,1,1, Trichloroethane
June 1990 - June 1991

Purchasing averages $67392.00

Disposal $16590.00

June 11, 1990	16 drums/9899 lbs.	$2400.00
Septebmer 20, 1990	16 drums/9895 lbs.	$2400.00
December 3, 1990	12 drums/7340 lbs.	$1800.00
February 14, 1991	13 drums/7967 lbs.	$1950.00
June 3, 1991	13 drums/7813 lbs.	$1950.00
June 3, 1991 (oil)	42 drums/17918 lbs.	$6090.00

Pollution Prevention Fees
85845 lbs. of toxic chemicals reported released multiplied by $0.02, rounded to the nearest dollar. $1717.00

A total of 1 toxic chemical reported released $150.00

County Fees
License fee from Scott County for all toxic chemicals $1085.00
(is not broke down by chemical)

Waste Analysis
Hazardous waste analysis on contaminated oil $375.00

Chlor-D-Tech tests for oil (100 pieces) $600.00

Total Cost $87309.00

Estimated Savings
Alkaline cleaner costs to replace 1,1,1, Trichloroethane
mixed at 1:10 ratio x 750 gallons/year x $7.25/gallon $5438.00
Electricity to heat cleaner rinse $900.00
Waste usage $100.00

$87309.00	Total cost 1,1,1, Trichloroethane/year
6438.00	Total cost Alkaline/year
$80871.00	Estimated yearly savings/year

Case Study:
Managing Solvents and Wipers

Jeffrey R. Adrian

Company:
The John Roberts Company
Location:
Minneapolis, Minnesota
Number of Employees:
240
Business:
Commercial printer of annual reports, brochures, catalogs, forms, limited-edition fine art prints, and direct mail pieces using both sheet-fed offset and web offset technologies
Program:
Self-audit the relationship between shop towels and solvents, implement more environmentally sound solvents where possible, reduce through centrifuge recovery the volume of solvents left in shop towels
Objective:
Reduce toxicity and quantity of solvents in shop towels sent to commercial laundry for cleaning
Bottom Line:
Cost of program, $20,000. First year payback, $18,000+ on substituting less volatile solvents and $30,000+ on recovery of solvents for reuse. Source reduction of seventy-eight 55-gallon drums/year that would otherwise be purchased for operation where recovered solvent is now used.

BEING RESPONSIVE to the needs of the environment means learning new procedures and employing new tools to do the same job with less waste. This case study describes a successful program of source reduction and reuse at the John Roberts Company. In particular, we will demonstrate (1) how a self-audit of solvents used in printing operations led to substitution of more environmentally sound solvents with less waste being generated and (2) how the use of a centrifuge to extract solvents from industrial wipers prior to laundering resulted in reduced volume of solvents in wastewater.

Background

The John Roberts Company is a commercial printer of annual reports, brochures, catalogs, forms, limited edition fine art. prints, and direct mail pieces using both sheet-fed offset and web offset technologies. The company currently employs more than 240 people and generates annual sales in excess of $34 million.

The first opportunity for the company to really understand its solvent history was the result of a problem encountered by the industrial laundry that washes the press wipers used for cleanup. The effluent from the laundry's washing process had become of considerable concern to the Metropolitan Waste Control Commission (MWCC), the agency that oversees the sanitary sewer system in the seven-county metropolitan area.

Printing requires the use of some kind of wiper for press cleanup. These may be disposables, ordinary rags, or leased towels. Many printing firms, including the John Roberts Company, have chosen to use leased towels for their wipers, believing they are less cause for concern when it comes to problems of lint contaminating the press. Traditionally, leased towels were sent to the industrial laundry for cleaning, and with them went a great deal of ink and "spent" solvents. It was the presence of these solvents in the wipers that was creating problems for the industrial laundry and for the community sanitary sewer system that must handle the effluent from the laundry. Two major concerns are flammability and toxicity.

The Metropolitan Waste Control Commission had approached the

***Jeffrey R. Adrian** is the Environmental Director for the John Roberts Company in Minneapolis.*

company's industrial laundry with a problem. Specifically, the nature of the solvents used by printers was such that vapors leaving the effluent from the laundry exceeded the lower explosive limit (LEL), and there was a consensus that too much solvent was being washed out of the leased towels. The laundry in turn asked its major printer customers and our trade association, the Printing Industry of Minnesota, Inc. (PIM), to work out a solution. The incentive to do so was clear: the laundry would retain an important segment of its business and the printers would be able to continue using leased textiles for press wipers.

. . . the company's primary task was to find a suitable blanket wash that balanced the production need for speed with environmental needs of less toxicity and volatility.

Faced with this challenge, John Roberts decided to concentrate on two main objectives: (1) to change the *nature* of the solvent that was left in the towels as a by-product of cleaning presses, and (2) to reduce the *volume* of solvent left in the towels.

The Nature of the Solvents

The first step was to examine the nature of the solvents used to clean the presses. More information was needed about the kinds of tasks solvents must accomplish in our production and the conditions under which these solvents perform.

As a result of intensive questioning of everyone involved in the process, a list of necessary solvent criteria was drawn up:

1. For washing press blankets, a solvent must be able to work quickly in cutting ink, leave the blanket free of any oily residue, and dry almost immediately. Time is critical during the course of a press run, and the ability to get back up to color quickly would reduce waste of stock before again printing good sheets.
2. For cleaning the metal parts of a press, such as ink fountains and trays, as well as the second step of a two-step roller wash, a slower-working solvent that could still cut the ink would be suitable as a general press wash. Speed is a lesser priority here as these activities usually occur between press runs.
3. For cleaning the chain of ink rollers, a solvent that is slow to evaporate is needed. This solvent must not flash off before it has gone through the entire sequence of rollers to the very last one or it will fail to clean them adequately.
4. On a limited basis, a very aggressive solvent with high cutting properties is needed for removing hardened ink that sometimes collects on impression or back cylinders of the press.

In light of these criteria, it seemed evident that the company's primary task was to find a suitable blanket wash that balanced the production need for speed with environmental needs of less toxicity and volatility.

Press operators prefer solvents that flash off quickly and do not require a lot of repetitive wiping or leave behind an oily film. Unfor-

tunately, most solvents with these desirable properties from a production point of view, also create problems for the industrial laundry by exceeding the LEL level. When we audited our operations with regard to specific solvents being used at John Roberts Company, we discovered that press operators had for some time been using a highly volatile solvent called Type Wash as a general, all-purpose solvent. This product, which is a blend of acetone, toluene, MEK, and isopropyl alcohol, was not only a contributor to in-plant volatile organic compounds (VOCs) in the air, but also negatively affected the laundry's effluent.

This particular solvent (Type Wash) was never intended for the use it was being put to, and our investigation suggested that its use was probably the result of the many personnel changes that had occurred locally in the industry a few years previously. This solvent, once used, had easily become a habit that was hard to break.

Because Type Wash flashed off so readily, no time was lost by the pressmen. That is, they didn't have to rub the blankets repeatedly and stubborn, hardened ink was easily removed. It was easy to see why this solvent was so popular. Unfortunately, it was this same propensity to flash off quickly, which was good for production, that caused so many problems with the laundry's effluent and was so bad for the environment.

As Type Wash's properties were analyzed further, it was found that almost half the total volume of this solvent, nearly 46 percent, was wasted. It had simply evaporated before the work could be performed!

Our goal would be to find a substitute solvent that was better matched to the task it was to perform and that did not substantially affect work procedures or productivity.

The human factor

Our goal would be to find a substitute solvent that was better matched to the task it was to perform and that did not substantially affect work procedures or productivity.

It should be noted that it was not sufficient to just find a technical solution to the problem. For success to be possible, the support of upper management was vital, as well as the cooperation and understanding of press personnel.

The support of upper management was expressed to the plant personnel in the form of a clear understanding that, in learning to work with new solvents, some procedural changes may affect productivity slightly, but that small losses here would not reflect negatively on the overall performance evaluations of the press personnel.

To obtain the support of the press personnel themselves, we first sought to ground these efforts solidly in why it was necessary to make this change and in how this change was to be accomplished. They very much needed to know that they were a large part of this project and that their experience and opinions were vital to the project's success. Over time, each individual pressman and floor helper was sought out for his or her input.

The net result of finding and implementing a good substitute

. . . before wipers are sent out for cleaning, they are spun in a safe, explosion-proof centrifuge, which extracts and recovers between two-and-a-half and three-and-a-half gallons of "spent" solvent for every load of approximately 220 wipers processed.

solvent was a major reduction in the misuse of the solvent that was the cause of so much concern. Type Wash, which had a projected usage of one-hundred-and-fifty-two 55-gallon drums for 1989, and an even higher projected usage for 1990 had the company made no substitution, was reduced to just five drums in all of 1990. Yes, the company still uses Type Wash, but only where its use can be justified. The new replacement solvent, an Ultra-Fast Blanket Wash blended especially for the company, provided the performance parameters of reasonable speed in use and lack of an oily film left behind.[1] And, in comparison to the previous year, only thirty-eight 55-gallon drums of the new Blanket Wash were purchased in 1990. Consequently, the net savings to the John Roberts Company, even after including the purchase of the replacement solvent, amounted to more than $18,000 the first year.

Most importantly, by selecting a replacement solvent blend with a lower evaporation rate for use as a Blanket Wash and by strictly limiting use of Type Wash, the problem of excessive LELs in the commercial laundry's effluent from the washing of graphic arts wipers was solved, at least as far as any contributed by John Roberts.

The Volume of Solvents

Having successfully changed the nature of the solvents left in the wipers, the company turned to its second objective: to find a way to reduce the total volume of solvents left in the towels.

With the help of its trade association, the Printing Industry of Minnesota, Inc. (PIM), the company began to explore ways to "wring out" the wipers. The first logical step was to review current procedures to make sure that over time previous efforts to train employees not to dump excess solvent in the pile of used wipers had not eroded. In the past, this practice was common throughout the printing industry.

Having satisfied ourselves that no ground had been lost here, we were certain that the wipers being readied for return to the industrial laundry for cleaning had the "minimum" amount of solvents retained. The wipers were dirty with ink and they had a strong odor, but none was dripping with solvent. In fact, in a practical test, wringing by hand failed to yield any solvent from the wipers.

Next, the company explored the use of a commercial grade laundry centrifuge, suitably adapted for our intended use. We were very surprised to learn that the "minimum" amount of solvent retained in the wipers was much more than we had originally thought.

Today, before wipers are sent out for cleaning, they are spun in a safe, explosion-proof centrifuge, which extracts and recovers between two-and-a-half and three-and-a-half gallons of "spent" solvent for every load of approximately 220 wipers processed. As about 7,000 wipers a week are used at the John Roberts Company, over time that amounts to quite a lot of solvent recovered. Instead of going out with the wipers to the laundry, this recovered solvent is now reused throughout the plant as solvent in a series of parts washers to clean press ink trays. Essentially, a slightly dirty solvent is being reused to

do our dirtiest task. More than 5,100 gallons of spent solvent were prevented from reaching the laundry's effluent last year.

Reuse of the partially spent solvent recovered from the centrifuge program eliminates more than one drum a week of virgin solvent that would otherwise be introduced into the system to fill parts washers throughout the plant. A welcome bonus of the centrifuge recovery program has been substantial savings to the company, amounting to more than $34,000 in the first year alone. For the John Roberts Company, one of the first companies to install such a system, the payback on the cost of the centrifuge, about $15,000 installed, was quicker than expected.

The centrifuge program has been in operation for a little more than a year. In that time, a measurable decrease in soil weight of the wipers being sent out to the laundry for cleaning has been achieved, resulting in a sizeable reduction in the volume of solvents sent through the sewer system, ultimately reaching the Mississippi River.

As we have gained more experience with the capabilities of our centrifuge extractor, we have discovered that oils too can be recovered from the many types of sorbents, such as socks, tubes, pads, and pillows used to capture small spills. This has had a side benefit of allowing several reuses of these sorbent materials, as they are costly, and the further removal and recovery of almost all absorbed solvents and oils before disposal of the sorbent materials themselves.

A Low-Tech Solution

This project may be unique compared to other projects in that it is decidedly low-tech. That is to say, we took readily available procedures and equipment and in an orderly way went about assessing both the degree and the extent of the problem. We applied the knowledge we acquired through our own research, we sought the assistance of our trade association, and we dealt with the problem in its context, seeking to maximize all aspects.

. . . for the John Roberts Company, the program of solvent reevaluation, substitution, and centrifuge recovery has served as its entry into an active policy of source reduction, reuse, and recycling.

The results are a methodology that is reasonably affordable, that is certainly very effective, that has been readily adapted (a mobile version of the centrifuge has already been established as new business by one of the association's members), and that can be readily transferred to other industries (anyone using oils or solvents along with wipers might benefit).

Additionally, for the John Roberts Company, the program of solvent reevaluation, substitution, and centrifuge recovery has served as its entry into an active policy of source reduction, reuse, and recycling. Though the company had not specifically set out to begin a program of waste minimization and source reduction, we had found a way to practice both!

The Future

Although we have found what appears to be a solvent solution for today, we know that the work must continue. We are very pleased

with our new Blanket Wash, but as we look toward the future, we know we cannot afford to stop here. Some of our Blanket Wash's performance characteristics are due to chemical ingredients that sometime in the future, perhaps as soon as 1993, will have to be replaced with more desirable chemicals from an environmental point of view. In expectation of this fact, we have already begun to search out and test for those replacements today. ◆

Note

1. The chemical composition of Ultra-Fast Blanket Wash is: Filmcol A2/200, Toluol, 1,1,1 Trichloroethane (approx. 24%), and Rule 66 Mineral Spirits. We intend to try to find a suitable substitute for trichloroethane while retaining the performance characteristics of the blend. We are testing regularly with replacement in mind for 1993.

Case Study: Parker Pen's Total Quality Management Strategy to Prevent Pollution from Solvents

John C. Houseman

Company:
Parker Pen USA, Ltd.
Location:
Janesville, Wisconsin
Number of Employees:
575 in Janesville
Business:
Manufacture and marketing of refillable writing instruments
Program:
Total quality management techniques applied to reduce solvent use
Objective:
Reduce trichloroethylene (TCE) usage by 50 percent
Bottom line:
A 54 percent reduction in TCE usage, saving $70,000 over a three-year period.

PARKER PEN USA, Ltd., a leading manufacturer of high-line writing instruments, produces millions of components, refills, and whole instruments annually. Numerous progressive die presses produce metal caps, barrels, buttons, and refill shells from strip stock. Solvents are used throughout the plant, mainly in vapor degreasers. Vapor degreasers are required to remove the drawing oils from the formed parts before finishing operations are performed. In addition, other operations within the plant require that contamination be removed from metal parts in vapor degreasers.

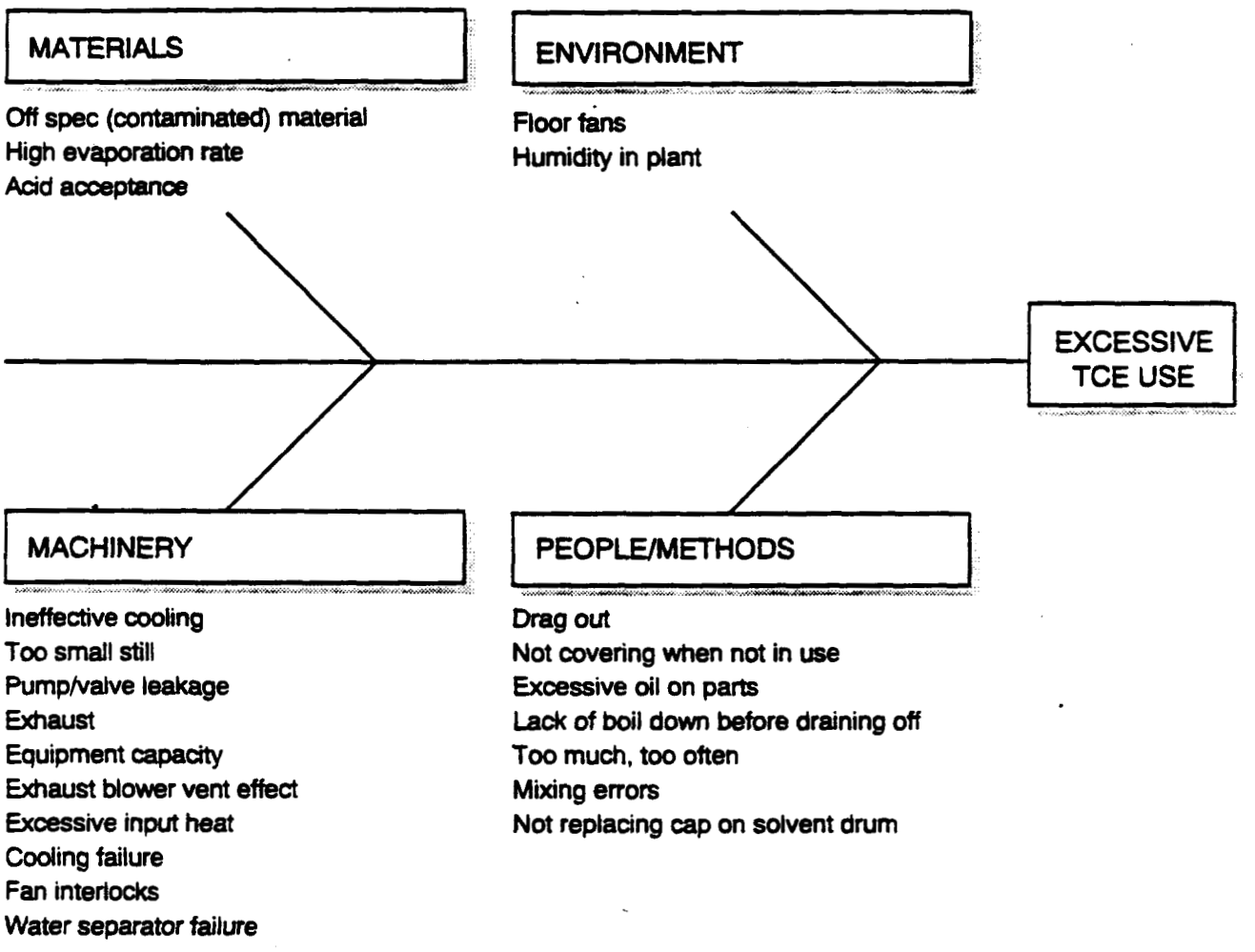
Recently, Parker Pen USA succeeded in significantly reducing trichloroethylene (TCE) solvent emissions at its Janesville, Wisconsin, plant by applying total quality management (TQM) problem-solving techniques, including quality improvement teams and statistical process control analysis. For Parker, the TQM approach and the expertise of the plant's supplier of TCE were the right elements to achieve rapid reduction in solvent usage with little capital investment.

The Voluntary Improvement Process

When solvent usage and emissions data were summarized to complete Parker's first SARA Title III, Section 313 report, the emissions numbers were higher than expected. At the same time, Parker Pen USA had just begun to experiment with TQM concepts. One of its first initiatives was to develop its own version of TQM's quality improvement teams known as the voluntary improvement process (VIP). VIP relies on cross-functional teams that are assembled to research, recommend, and implement solutions to specific operational problems within the company. Finding ways to reduce solvent emissions seemed like an ideal opportunity to apply the VIP team approach to benefit the environment and reduce expenses for the company.

***John C. Houseman** is the plant engineer manager for Parker Pen USA, Ltd. This article has been adapted from a paper originally presented at the Hazardous Materials and Environmental Management Conference in Central Rosemont, Illinois, March 10-12, 1992.*

Figure 1. Cause-and-Effect Diagram of Factors Contributing to Excessive Use of TCE



Three degreaser operators, a maintenance person, an engineer, the plant engineering manager, and the buyer responsible for purchasing solvents readily volunteered to serve on a solvent usage reduction team. VIP protocol required the team to follow these steps:

- Clearly state the problem
- Develop a mission statement
- Collect data on current conditions
- Develop a strategy to accomplish the mission
- Implement specific improvement projects
- Monitor progress through continuous data collection
- Document all changes
- Disband team

. . . at the first meeting, the VIP team agreed to focus on reducing TCE usage . . . the team . . . reached a consensus that a 50 percent reduction, using 1988 as the base year, would be a significant accomplishment.

In this instance, the problem was that solvent use had risen sharply in recent years without regard for the impact this increase was having on plant emission levels or costs. Records indicated that TCE was the solvent most frequently used in the plant. Thus, at the first meeting, the VIP team agreed to focus on reducing TCE usage. After much discussion, the team also reached a consensus that a 50 percent reduction, using 1988 as the base year, would be a significant accomplishment.

Statistical process control analysis

Although there were data available on plantwide usage of TCE, there were no data specific to each degreaser. Nevertheless, TCE usage had to be compared degreaser by degreaser to effectively gauge the results of specific improvement projects. The next step was to document current levels of TCE use for each degreaser and develop procedures to continue to monitor usage.

At this point the team members used their training in statistical process control (SPC) analysis to evaluate the uses of TCE. Quality guru Kaoru Ishikawa's cause-and-effect or fishbone diagram was determined to be the best technique to illustrate all the possible causes of excessive use of TCE. (See **Figure 1**) For this exercise, the following general "cause" categories were selected: (1) materials, (2) people and methods, (3) machinery, and (4) the surrounding plant environment. Specific questions and concerns are discussed below.

1. What effect do materials have on solvent usage?

- If the raw solvent does not meet specifications, the parts may need to be processed through the degreaser more than once, necessitating additional solvent.
- If the acid acceptance capability of the solvent is too low, it must be replaced, otherwise potentially dangerous wear to the degreasing equipment can occur.

2. How can worker training or improved operating practices affect solvent usage?

- On manual degreasers, improper placement of the parts into or out of the degreaser causes drag-out of solvent into the ambient air.
- Not covering the top of a degreaser tank when it is not in use leads to unnecessary releases of the solvent vapor into the plant.
- The more contamination there is on the parts, the greater the amount of solvent required to clean the parts.
- If different solvent materials are combined in the same degreaser, all the solvent has to be removed and sent out for reprocessing.
- Removing a portion of the dirty solvent to reduce the oil contamination had been a common practice, although it was not the most efficient approach.
- Leakage can occur if the solvent drum cap is not tight.

3. What does the plant environment near the degreaser have to do with solvent usage?

- Floor fans, or even improperly positioned building ventilation supply grilles, can produce air currents that draw solvent out of the degreaser into the surrounding air.
- Excessive humidity in the plant may cause water vapor to condense into the solvent tank, unnecessarily reducing the useful life of the solvent.

4. How does the degreasing equipment contribute to excessive solvent use?

- Inefficient cooling coils can allow vaporized solvent to escape out the top of the degreaser into the plant air.
- If the degreaser still capacity is not large enough to keep the degreasing tank solvent clean, large amounts of contaminated solvent will need to be removed to maintain the quality of the part degreasing process.
- Improper local or lip exhaust vent can generate additional solvent vapor from the degreaser that is released through ducts and out of the building into the air surrounding the plant.
- Operating this exhaust vent when the degreaser is not being used generates the same effect as described above.
- Heating the solvent too vigorously can place excessive strain on the cooling coils and result in solvent vapors escaping from the degreaser.
- Nonfunctioning water separators can lead to water accumulation in the degreaser. This results in a general breakdown of the solvent, necessitating its total replacement.

. . . a senior technical representative from Dow was brought in to provide basic solvent training for all operators and maintenance personnel, along with a detailed review of mechanical operation and procedures for each of the plant's seven degreaser/still combination units.

The cause and effect analysis made it clear that there were many more questions to be asked before the team could develop a strategy that would target reductions at those points in the operation where the most solvent was being lost. This led the group to contact Dow Chemical, the plant's supplier of TCE, to find out what help it could provide. Fortunately, Dow has a training program available under its ChemAware Program that also offers vapor monitoring services and acid acceptance kits to customers. To begin addressing the issues highlighted by the fishbone analysis, a senior technical representative from Dow was brought in to provide basic solvent training for all operators and maintenance personnel, along with a detailed review of mechanical operation and procedures for each of the plant's seven degreaser/still combination units.

Supplier recommendations

Once the Dow Chemical representative had completed his review of the degreasing equipment and procedures, the magnitude of the task ahead became even clearer. Each degreaser/still combination had a minimum of six to a maximum of twelve recommendations for

improving its operation. A summary of these recommendations is listed below.

North End Degreaser

1. Reduce excessive boiling action by removing two electric heating elements.
2. Check water flow and temperature. Inlet water should be between 50°F and 60° F and exit water should be between 90°F and 100° F.
3. Put internal resting hooks along the degreaser side walls, so the work load can be left in the freeboard area for the five to ten minutes' drying time.
4. Remove parts from the vapor zone no more than two linear feet per minute.
5. Always run the still when operating the degreaser.
6. Check the still boiling sump thermometer to see that it is calibrated properly.

Vibratory Degreaser

1. Clean condensing coils to bare metal to improve heat transfer.
2. Check temperature of the water inlet and exit.
3. Repair nonfunctional water separator.

Ballpen Shell Degreaser

1. Clean condensing coils to bare metal to improve heat transfer.
2. Check water flow and temperature.
3. Correct excessive generation of vapors by disconnecting a heating element.
4. Recalibrate the boiling sump thermometer.

Metals Department Degreaser

1. Program hoist to use the "stop-and-go" technique.
2. Reduce hoist speed to two linear feet per minute.
3. Remove one heating element from boiling sump if it is boiling too vigorously.
4. Clean condensing coils to bare metal.
5. Check water flow and temperature.
6. Check operation of floats in still.

Concurrent with the training and procedures review, the VIP team developed a Pareto graph from the cause-and-effect diagram. The Pareto principle sometimes is called the "80-20 rule" because approximately 80 percent of a problem can usually be attributed to 20 percent of its possible causes. Completion of the Pareto diagram would, in theory, reveal which conditions were the most responsible for excessive solvent use, thus providing a prioritized list of items to investigate.

Still, the team needed more information before they could com-

plete a Pareto diagram. Because industrial hygiene testing showed that the air surrounding the degreasers had a very low concentration of solvent, the team initially looked to the degreaser exhaust vents as the primary source of the losses. That assumption was dismissed, however, when the Dow Chemical technical representative performed stack emission testing and came up with surprising results. The five degreaser exhaust vents tested were expelling a total volume of 1.2 pounds of solvent per hour, which ruled out the possibility that the majority of the solvent was escaping through the exhaust stacks.

In the VIP team's continued search for other operational practices that led to excessive solvent usage, one practice stood out: the vapor degreasing of wire coil stock in a piece part degreaser. These coils must be cleaned right before use and no other equipment in the plant was large enough to accept the coil stock and remove the anti-tarnish coating on the coil. As a result, the coils were being cleaned in the North End degreaser and the anti-tarnish coating contaminated all the solvent in the degreaser after each use. Furthermore, because of this practice, some solvent was being sent out for reclaim with only ten percent contamination.

Once this problem was identified, the VIP team alerted the department (refill point production for pens) that was requiring that the coil stock be cleaned. After making little progress trying to clean the coil stock elsewhere, the VIP team looked for other ways to facilitate a change in procedure. In the process, the team discovered that, because the coil stock was being cleaned outside the point making department, that department was not absorbing the entire cost of the cleaning. At the same time, the VIP team calculated the total cost of cleaning the coil stock, including the labor and material needed to replace the contaminated solvent after every cleaning. Armed with bottom-line figures of what solvent waste caused by this practice was costing the plant, the VIP team approached the accounting group and persuaded them to institute procedures to charge the excessive solvent use to the point making department.

Armed with bottom-line figures of what solvent waste caused by this practice was costing the plant, the VIP team approached the accounting group and persuaded them to institute procedures to charge the excessive solvent use to the point making department.

Once the point making department was being charged the total cost of the coil cleaning process, they could see its full financial impact as an ongoing expense. This soon motivated staff in this department to form its own team to evaluate alternate cleaning methods. Ultimately, they used the cost of solvent under existing procedures in a proposal to justify the purchase of a parts washer exclusively for coil stock.

Implementing the Change on the Line

During the VIP team's weekly one-hour meetings, participants learned a lot more about degreasers and good operating procedures than they had ever known before. For example, it was discovered that boiling sumps don't have to boil vigorously. In fact, excessive boiling wastes solvent and energy. Consequently, the heat input to the boiling sumps was on average reduced by 50 percent.

The group also learned that one of the best methods of lowering

solvent use is to limit the contamination getting into the degreaser. Explaining to press operators, during training, that one drop of oil contaminates six drops of solvent gave them a reason to reduce the amount of oil getting on the parts in the first place.

Explaining to press operators, during training, that one drop of oil contaminates six drops of solvent gave them a reason to reduce the amount of oil getting on the parts in the first place.

Other operating practice modifications were instituted to minimize contamination. Some of these modifications were easily adopted, while others took more time. For example, parts baskets going in and out of the degreaser were limited to a rate of no more than two linear feet per minute with a stop in the vapor zone to allow as much liquid solvent as possible to return to the sump. Deviating from this procedure would push an unnecessary amount of solvent out of the degreaser. Fortunately, three of the degreasers have an automated programmable hoist to lift parts in and out of the degreaser. Reprogramming these units was easy. Two of the other degreasers were operated manually, however, and operators had to be trained to gauge the relative speed with which they took parts in and out of the degreaser and stopped in the vapor zone.

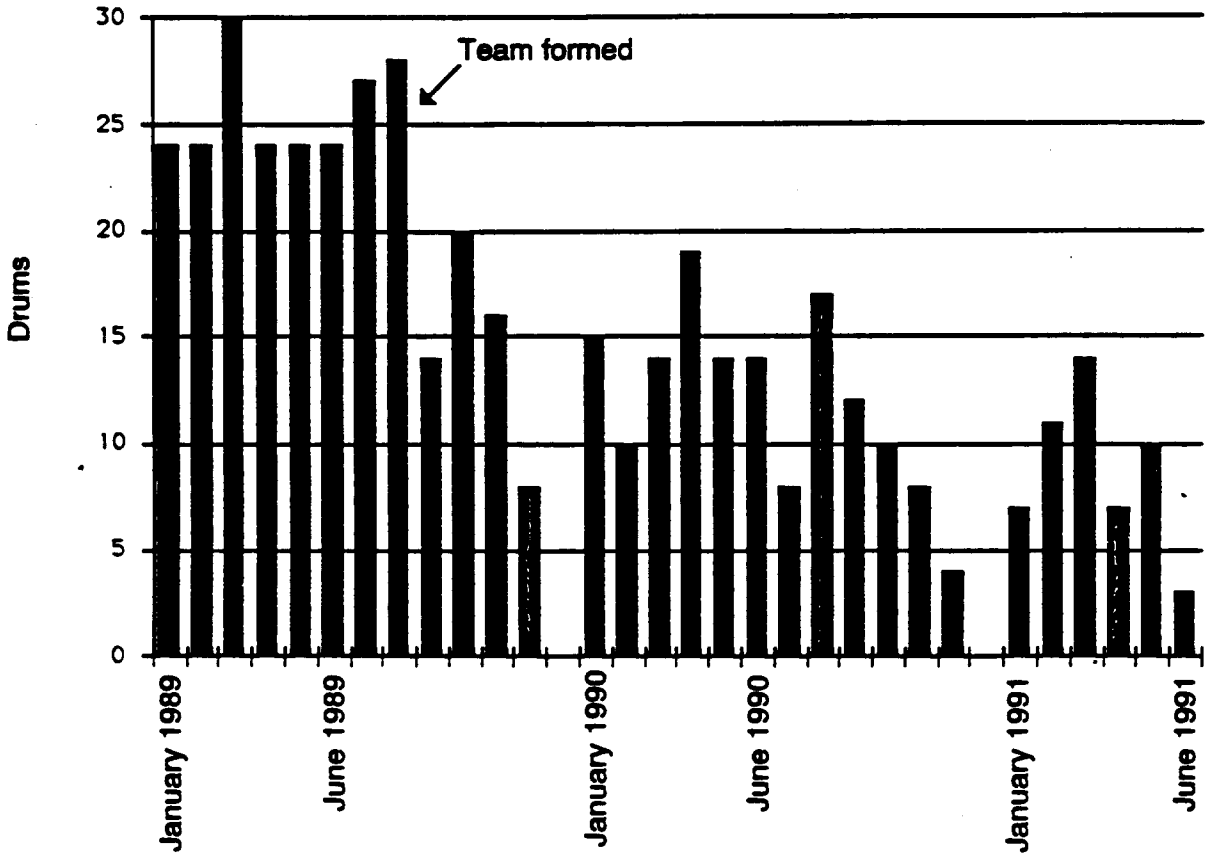
One simple method that has been adopted to extend the life of the solvent is to periodically transfer all the solvent to the still and boil the solvent off, returning it to the degreaser so that the contamination remains in the still. The remaining liquid is then drained from the still into a drum and sent out for reclaim. This process has allowed an increase in the average contamination level of spent solvent from less than 20 percent to 65 to 70 percent. Because the line operates on a three-shift basis, however, consistency of methods and procedures is always a concern. Therefore, the maintenance engineer and maintenance mechanic designed an automated system for the two degreasers with the greatest throughput in order to control the process. A programmable logic controller was added to the degreaser control circuit to first alert the operator that a boil down is needed and then, when initiated, automatically perform the boil down. This procedure has greatly reduced the risk of an operator error occurring and markedly improved the consistency of the process.

The Results

In the six months after the improvement project began, monthly usage of TCE dropped from twenty-five to fifteen drums (see **Figure 2**). During that same period, production requirements were rising. In addition, the quantity of solvent sent out for reclaim dropped from sixteen to ten drums monthly.

The first year reduction in TCE purchases amounted to a $30,000 savings to Parker. Annual hazardous waste volume decreased by 36,000 pounds. The amount of solvent reclaimed also dropped, however, due to the reduction of solvent in the degreaser sludge, which negated any dollar savings. These improvements in the efficiency of solvent use were generated with a total capital investment of $14,500—$10,000 for the aqueous cleaning system for coil stock and $4,500 to add automatic boil down controls to the two degreasers. Minor

Figure 2. Reduction in TCE Use
January 1989 - June 1991



equipment modifications and weekly VIP team meeting costs were charged to normal departmental operating expense accounts.

To date, Parker's Janesville facility has reduced its TCE usage by 54 percent, saving $70,000 over a three-year period. The company's success with TQM and solvent reduction was also a major factor leading to its selection in 1991 as a recipient of one of ten Business Friend of the Environment Awards given by the Wisconsin Environmental Working Group and the Wisconsin Manufacturers and Commerce Group.

The role of the total quality VIP approach in accomplishing these results cannot be over-emphasized. Without the firm commitment to satisfying the customer, internal as well as external, the many functional areas involved in solvent purchase, use, and waste disposal would not have gotten together. The VIP process facilitated the transfer of information between operators and maintenance, pur-

chasing and engineering, and the supplier and operators. Operators learned more about their equipment and the importance of running it properly. Maintenance learned that operators are a good source of information on how equipment is performing on a day-to-day basis. Engineering learned that with some additional training, operators can provide valuable insights into process problems. Purchasing learned that suppliers can be an invaluable source of knowledge on the products they provide.

None of the procedural or equipment changes were particularly difficult to accomplish. Once all the affected parties agreed to form the VIP team, the greatest hurdle to success was cleared. By involving employees at the beginning, a better solution to the problem was found and everyone was committed to implementing the solution. For example, rather than viewing the automation of the boil down process as a threat to their individuality, operators understood the necessity of using an automated system to ensure that this complicated procedure was performed correctly each and every time.

The success of Parker's solvent usage reduction VIP team makes a strong case supporting the total quality management process. Pollution prevention need not cost a lot of money or take a large staff of environmental professionals to attain the desired result. By actively soliciting employee involvement, encouraging teamwork at all levels of the organization, and giving people the responsibility and freedom to make change, great strides in operational and environmental performance can be achieved. ◆

V. Evaluation and Implementation

Implementation of pollution prevention activities ultimately depends on the value-added to the business as well as the technical feasibility. Waste reduction measures are not likely to be incorporated without a full understanding of the costs and benefits associated with the option. For industry practitioners, the ability to do an accurate and comprehensive cost/benefit analysis is the cornerstone of sound pollution prevention decision-making.

Most industrial waste generators will have had some practical experience in preparing financial summaries and cost/benefit analyses for proposed projects. Agency input should build on these existing skills.

The new learning to be gained by the industrial waste generators is likely to center on the identification and computation of the "hidden" costs associated with environmental management and how they can be incorporated into a project evaluation.

Full Economic Analysis

Although materials savings and emissions reductions are important pieces of information in evaluating a pollution prevention activity, many other issues which have tangible cost/benefit implications must be considered before implementing a project. The best analyses fully identify and incorporate all related costs, expenses, and returns associated with project implementation--both in the present and in the future--to determine economic viability.

The EPA Pollution Prevention Benefits Manual breaks down an economic analysis into four cost "tiers." Tier 0 addresses usual capital, operating, and maintenance costs associated implementing and operating a new production method. Tier 1 costs include "hidden " costs associated with pollution practices. Tier 2 considers potential liability costs. Tier 3 includes less tangible benefits a company may achieve as a result of implementing the new technology. Table 1 highlights the cost components found in each tier. As expected, the higher the tier, the more subjective the cost/benefit figures become.

All relevant Tier 0 factors should be quantified in evaluating a pollution prevention option as they would be in evaluating any production system

change. To the extent feasible, higher tier cost factors should be quantified and included in the assessment. Frequently, managers will neither identify nor attempt to quantify many of the "hidden" costs associated with environmental management and will not include their impacts in the evaluation of a pollution prevention project.

A full scale discussion of economic evaluation and payback calculation methods is beyond the scope of this overview. The point of this short discussion is to draw attention to costs and issues which may otherwise not be considered and encourage waste generators to examine these issues as well when reviewing pollution prevention options. Those desiring additional information on the specifics of economic analysis and review are encourage to obtain the EPA Benefits Manual listed in the bibliography section.

A final consideration on pollution prevention implementation is that product performance and quality are prima facie issues--if these are substantively and negatively affected, a production change is not justified. Similarly, a number of other site conditions such as corporate priorities and goals, availability of capital, organizational structure and behavior,and availability of human resources must also be recognized as legitimate and powerful implementation issues.

Partners in Prevention- Choosing a Consultant

One of the most vexing issues manufacturers face in the area of waste management is the selection of a competent consultant to assist them in making decisions related to waste generation and production processes. Even though guide provides participants with a number of tools that will allow them to make better decisions as they look to alter their current cleaning and degreasing processes, both consultants and vendors are likely to play and important role in the planning and implementation of such a project.

Consultants can provide a variety of services in choosing an alternative cleaning system. These include:

- objective assessment of the situation
- assistance in interpreting regulatory considerations
- analysis of alternatives
- predesign, design, and engineering support

- assistance in vendor selection and procurement
- perform an independent evaluation of competing proposals

Reputable suppliers are likely to be expert in specific systems and applications. Consultants often bring a broad view of systems and applications, and are therefore useful in dealing with a variety suppliers and cleaning systems. Bringing a consultant into the decision making process will assist the manufacturer by making sure the right questions are asked and that the new system is the best one for that particular manufacturer's needs.

It should be noted that in spite of this additional expertise, waste generators should understand that they and the people in their plants are the experts when it comes to their operations. Consultants should be used to augment the knowledge of company staff, not supersede it. There is no substitute for the exercise of good independent judgement, after having been fully informed. Industrial clients should not depend on consultants for decision making.

misunderstandings

The relationship between an client and consultant can be a tricky one. There are a number of areas in which misunderstandings can arise between the two parties, particularly as they negotiate contracts or letters of agreement. Trainees should be made aware of the following possible points of contention:

- who provides the necessary insurance coverage?
- are licenses and certifications needed on the part of the client or consultant?
- how are unforeseen expenses to be handled?
- will the consultant require a substantial amount of time or a workspace on site?
- will the information the consultant has access to be considered confidential and what written assurances are available to establish this confidentiality?

It is important to note that consultants or suppliers will submit proprietary data as part of their proposal or quotation. Industrial clients should be instructed that confidentiality runs both ways. Fairness suggests that the procurer of products or services keep this data confidential if expected by the consultant/supplier or warn the consultant in advance of their submission that the client will not do so.

Dealing with Suppliers

Being a "smart shopper" when it comes to deciding among the variety of alternative cleaning systems can save a manufacturer money and headaches in the future.

It is important to impress upon potential purchasers of alternate cleaning systems that it is up to them to anticipate any changes in manufacturing technology or the regulatory environment that might affect the system the are considering. Time must be taken by the company to analyze trends, research the range of options, and personally interview operators, not just owners, of systems they are considering. Short term thinking and knee jerk reactions to regulatory or other deadlines can lead to a decision the process operator will regret.

There are two excellent guides for choosing a consultant and/or supplier included at the end of this section.

Resources

Bibliography

"Purchaser and Supplier Guidelines," Metal Finishing Suppliers' Association, Inc.

"Selecting A Consultant," Factsheet, Minnesota Technical Assistance Program

Bibliography

Duns Consultant Directory, is a good reference that provides listings of consultants by area of expertise and location. It is updated annually and available in the business reference section of public libraries.

Shenson, H.L., How to Select and Manage Consultants, (1990) Lexington Books

Barcur, S.W., Handbook of Management Consulting Services, (1986) McGraw Hill

Metal Finishing Suppliers' Association, Incorporated

MFSA RECOMMENDED PURCHASER AND SUPPLIER GUIDELINES FOR THE DESIGN, PROCUREMENT, INSTALLATION AND OPERATION OF INDUSTRIAL WASTEWATER TREATMENT SYSTEMS

The Environmental Committee of the Metal Finishing Suppliers' Association, in order to guide the industries we represent and serve, as well as to keep the environment in which we all must live as attractive and healthful as possible, offers the following recommendations for the design, purchase, installation and operation of industrial wastewater treatment systems and/or components.

Wastewater treatment and recovery technology can seem overwhelming to some, and, while competing systems may appear to offer similar benefits, the serious buyer must know how to compare and evaluate various proposals.

The Environmental Committee of the Metal Finishing Suppliers' Association advocates that manufacturers of wastewater treatment plants have certain obligations to customers that are common to all. In addition, there is agreement by all reputable member suppliers that both the purchaser and user assume specific responsibilities for the safe and effective installation and operation of such systems. To promote greater understanding and to minimize potential disagreement, the Committee has adopted the following guidelines outlining these customer and supplier responsibilities:

GENERAL RESPONSIBILITIES

A. Suppliers

1. Provide a clear definition of the design parameters used for the wastewater treatment system including wastewater and effluent characteristics, service and maintenance requirements.

2. Start-up, operating and shut-down instructions are to be clear and complete.

3. Maintenance requirements are to be clearly defined.

4. Detailed recommended spare parts list are to be provided.

5. Supplier should provide a reasonable definition of start-up, operation and training services to be supplied with the system. Additional support services in these areas are to be provided at a stated, reasonable per diem charge.

801 N. Cass Ave, Westmont, IL 60559 (708) 887-0797; Fax (708) 887-1286

B. Purchasers/Owners

1. Where a user has advised a supplier that it will hold in confidence a supplier's proprietary data submitted along with or as a part of a proposal or quotation, or where a user has agreed to do so, the user may not properly publish such proprietary data, disclose it to others or include it in any revised request for proposals. If a user knows that a supplier expects that his data will be kept in confidence, fair dealing suggests that the user should either keep the data confidential or else first warn the supplier that the user will not do so.

2. Suppliers routinely design waste treatment system to meet current federal regulatory guidelines. However, owners must advise suppliers or bidders of any state or local regulations which may override federal requirements.

3. Owners are responsible to provide and maintain trained operators, including backup and security staff and procedures. Owners shall support training and certification of operating personnel as necessary.

4. Owners shall review and qualify operating procedures, operator competence and general system condition every six months and consult/advise supplier if additional support or training is required.

5. Owners are legally responsible to list all toxic substances and hazardous wastes associated with or generated by the process. Operators must be trained in the proper and correct chemical handling, storage and disposal procedures. Further, owners shall advise suppliers/manufacturer of any process changes.

6. Owners shall attach the same importance and give the same attention to the wastewater treatment and recovery systems as to production processes. Owners shall accept the importance and significance of data recording, maintenance procedures and schedules and prompt problem reporting.

To provide further guidance for the design, procurement, installation, start-up and operation of any wastewater treatment and/or recovery systems, the following general recommendations are offered:

PREDESIGN AND DESIGN CONSIDERATIONS

DO	DON'T
Reduce water consumption as low as possible. Add countercurrent rinses where possible.	Use more process or rinse water than required.
Segregate effluent streams wherever possible to reduce operating costs. Keep chromic acid and acidic streams in general separated from cyanide streams.	Mix all effluents together prior to treatment or recovery.
Keep domestic and non-process waters out of the process waste stream to be treated.	Undersize equipment. Undersizing affects performance and will not allow for flow surges or increased production.
Size the system capacity up to 50 percent beyond your current treatment needs to accommodate growth, unknowns and process changes.	Guess on design effluent flow rate.
Provide vendors with accurate flow rates and compositions, contaminate concentrations, surge rates, etc.	Treat effluent streams that do not require treatment.
Try to minimize or eliminate from your process those chemicals that can cause problems for the treatment system; i.e., chelates, sequestering agents, excessive oils, tumbling and burnishing compounds, etc.	Try to treat chemicals that current technology or chemistry cannot adequately cope with.
Minimize sludge generation. Consider metal recovery wherever possible. Recovered metal reduces sludge generation. Recovery may be economically viable.	Ignore recovery or sludge minimization possibilities.

WORKING WITH CONSULTANTS

DO	DON'T
Recognize that reputable suppliers are likely to be more expert than your consultant -- they have done this many times before.	Let your specifications override the supplier's best judgment and his "make-it-work" responsibility.
Consider only consultants with specific metal finishing pollution abatement experience. Check their references.	Believe everything you hear.
Consider retaining an independent, outside consultant if your in-house knowledge or time is limited.	Feel obligated to hire an outside engineer. Many reputable equipment and system suppliers routinely provide these services.
Work with the consultant to establish the "ground rules" for proposal requests and evaluation.	Let your consultant lock you into specific equipment or concepts, or have a commercial interest in your project.
Use your consultant to provide an independent evaluation of competing proposals.	Hire a consultant who is paid by anyone but you on your project.

PROCUREMENT OF NEW EQUIPMENT OR SYSTEMS

DO	DON'T
Request that new system bids include all pertinent equipment and operating costs, including estimated chemical and power usage, estimated fabrication time, allowances for freight, start-up and service charges.	Get quotes for a group of components. The associated system design and installation costs may be misleading unless you are experienced. This approach often results in overlooking critical equipment and/or services, may not take advantage of the best available treatment or recovery technology, and does not provide a single point of responsibility.

PROCUREMENT OF NEW EQUIPMENT OR SYSTEMS (cont.)

DO	DON'T
Make sure the cost for consulting and laboratory services are included if you purchase a system from a single supplier.	Forget to include any applicable consulting and laboratory services in the overall price.
Confirm that your system supplier has had experience in treating wastes similar to yours.	Let a potential supplier oversimplify your waste treatment requirements.
Personally observe or talk to owners or operators of typical supplier's systems operating on similar wastewaters.	Use general references of a supplier without checking the details.
When evaluating proposals and prices, consider and evaluate equipment design features, quality and vendor experience. Obtain explicit quotes on equipment; i.e., sizes, capacities, materials of construction, etc. Use a bid comparison layout or spread sheet to make comparisons.	Use price as the only criterion for evaluation or accept vague or misleading quotes.
Get several quotations for comparison before making your selection.	Select a supplier blindly or because an acquaintance dealt with that specific supplier. Many people and companies do not like to admit they may have been taken advantage of, or perhaps made a mistake.
Prior to purchase, discuss the proposal and commitments in person with a responsible person from the supplying company. He or she may not necessarily be the salesman.	Base buying decisions only on sales presentations or impressive brochures.
Beware of "black boxes" and unproven, new concepts. If under consideration, carefully check references and be conservative in sizing.	Look only at capital costs of new "black box" technology or accept unproven or radical design concepts without first pilot testing or negotiating a money back guarantee. Acceptance of concepts that are "magic" may well be tragic.

PROCUREMENT OF NEW EQUIPMENT OR SYSTEMS (cont.)

DO	DON'T
Recognize that, to be competitive, suppliers bear substantial pre-bid and bidding expenses, and, in certain circumstances paid engineering studies or design work are a normal and routine consequence and requirement of doing business in this field.	Thoughtlessly, "exercise" a supplier to provide unnecessary or fruitless proposals or consulting services.

EQUIPMENT WARRANTIES

DO	DON'T
Insist on standard one year warranty on material and workmanship for new equipment.	Accept non-specific warranties.

PERFORMANCE GUARANTEES

DO	DON'T
Request performance guarantees based on the specific wastewater data which you provide and certify.	Generalize or guess on system influent characteristics simply to get a specific warranty. Use federal industry limits without regard to local requirements.
Ask for a process guarantee from the system supplier and the independent consultant if one has been retained for your project.	Expect to get a complete system compliance guarantee from your suppliers or consultant if purchase order for the entire system is not given to one supplier.
Cover the manufacturing and installation timetable as well as all financial obligations and payment schedule.	Ask for an unlimited equipment or system guarantees or supplier service obligation.
Use pilot and/or lab testing, if possible, on a new application. Get any performance guarantees or limitations in writing from the supplier.	Accept testimonial claims without supporting data on the same or similar application.

PERFORMANCE GUARANTEES (cont.)

DO	DON'T
Include a procedure to rectify system problems during the warranty period. (Return of equipment is the last resort.)	Make "take-back only" a criterion for purchase.

OPERATION AND MAINTENANCE

DO	DON'T
If not performing the installation yourself, assign an individual to work closely with the supplier or contractor to become familiar with all parts of the equipment.	Expect to "learn it all" in a few days of start-up.
Prepare for start-up by first reviewing drawings and studying the operation manual.	Permit your people to show up for the start-up without having first developed prior knowledge of the system. Provide introductory waste treatment training.
Designate a well qualified individual as primary operator and provide the personnel and resources to support him or her.	Allow operating responsibility to fall to whomever is available.
To prevent abuses and provide a bank of knowledge for problem solving, advise and involve your chemists, maintenance, engineering and production personnel in the proper operation and benefits of your new wastewater treatment system.	Think that even the best system can be a "cure all" for responsible environmental management.
Establish and implement the regular maintenance program your supplier recommends.	Ignore the equipment or system until problems occur.
Alert supplier of any operating conditions which exceed the original system design parameters.	Hold the supplier responsible if original process design or flow parameters are exceeded.

INSTALLATION

DO	DON'T
Assure that the supplier provides adequate installation instructions and support. Advise the supplier of your critical requirements and site limitations.	Ignore supplier's recommendation or decline supplier proposed installation services. It can be the best insurance an owner can purchase.

UNDERSTANDING AND MANAGING YOUR OWN PROJECT

The foregoing recommendations and lists of DOs and DON'Ts have proved helpful to many MFSA members in addressing their specific needs. Since your requirements and circumstances may be different,

DO	DON'T
Get your own professional advice and guidance.	Rely only on the above suggestions in opposition to advice tailored to your own specific situation.

There is no substitute for the exercise of independent good judgment, after having been fully informed.

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MINNESOTA TECHNICAL ASSISTANCE PROGRAM

Fact Sheet

Selecting A Consultant

Starting any kind of pollution prevention or waste reduction project using resources at hand makes good financial sense. But if your project develops into a complex process, you may find that hiring a consultant to supplement your internal capabilities will help you get the job done faster. Also, a consultant can help you avoid making costly mistakes.

This fact sheet provides some basic information designed to help you choose a consultant. The variety of skills that consultants have to offer is vast. For this reason, the selection process requires careful research -- starting with your own situation.

Assess Your Needs

Begin your assessment by determining why your current method of operation does not meet your project objectives. Then, develop an overall picture of the work needed to achieve these objectives. Make certain that you document how measures such as process changes, product changes, materials substitutions and disposal cost reductions will affect company operations and profitability. Writing down information you gather regarding project objectives will help you later in the consultant selection process.

Key points of the project objectives to be reviewed should include:

- How much of the work you can do yourself
- What you can add to your internal resources by contacting equipment vendors and using public information sources such as libraries
- Which portions of the project are beyond your capabilities
- The dollars available for any project you might start
- How project implementation can save company dollars
- The level of company commitment to making changes affecting production processes

Understand the Consultant's Role

Now that you have researched your project objectives, you can compare your situation and needs to the types of services consultants offer.

(Over)

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The Minnesota Office of Waste Management's Mn TAP program is supported with a grant to the School of Public Health, Division of Environmental and Occupational Health, at the University of Minnesota.

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Consultants generally provide:

- Specific expertise and objective assessment of your situation
- Help in interpreting regulations
- A short-term supplement to your staff resources and knowledge base
- Analysis of alternatives and product life-cycle costing
- Implementation of recommendations
- Design and engineering support
- Assistance with equipment selection and ordering
- Completion of one-time projects
- Performance of annual tasks such as an environmental assessment
- Assistance in implementing change and operations start-up

Even this extensive list of services does not cover all the services consultants have to offer. However, you need to make sure that you do not become over reliant on consultants – causing you to forget that you are the expert when it comes to your company.

Therefore, you should not depend on consultants to provide:

- **Decision making:** You need to evaluate what will work for your business.
- **Purchasing of specific products:** Find out if the consultant receives compensation when you buy recommended products.
- **Standardized services:** Generally, consultants are hired to provide customized solutions for clients.

Once you have this information, you can decide how much outside help it would be reasonable to hire for your project.

When You Decide To Hire A Consultant

After it is agreed that consulting services offer the resources needed for implementation of your project objectives, identify the type of consultant that best meets your needs. If, for example, you are making process changes, you may need a consultant with specific design engineering experience. If the project is broad in scope you may need a consulting firm with broad experience and a larger staff.

To find the consulting help you need, you should:

- Get referrals for consultants from other local companies with similar operations, trade associations, legal counsel, regulatory/state agencies or consultant referral services.
- Contact these consultants to identify their interest and experience.

Before Your First Meeting, Prepare Your Information

To prepare for the selection process, you should create a document outlining your project objectives and your current situation.

When you meet with the consultants you have identified as fitting your situation, explain what you feel you are able to accomplish with – and without – consulting assistance.

During the meeting you need to:

- Define what you want the consultant to do – but explain that their opinions are welcome. An outside perspective on your situation is valuable.
- Identify the consultant's experience working on projects similar to yours.
- Find out who would be working on your project.
- Ask for references to verify the consultant's work. Checking past performance is one of the best ways to evaluate a consultant.

At the end of the meeting, request a proposal from the consultant based on the documented information you provided – and on the information shared in the meeting. Be sure to respond if any of the consultants you are considering request more information. Clear communication at this stage is vital. It helps assure that you will get the results you want.

Review the Proposal

When you receive your proposal, make sure that it answers the following questions.

- What does the consultant regard as your principle needs based on your objectives?
- What services make each consultant unique?
- Is a project timetable for the consultant and your personnel included, and is it reasonable?
- Are all fees and equipment costs clearly explained – including billing procedures?

Also, a written proposal should spell out:

- Responsibilities of your personnel
- Responsibilities of the consultant or consultants
- The personnel assigned to the project – including their experience levels and billing rates
- References relevant to your project

Avoid Misunderstandings

The following are issues cited as being the ones most often neglected when hiring a consultant. Consider addressing these concerns in your contract or letter of agreement:

- **Use of subcontractors:** Does the consultant use subcontractors and assess a commission for their services?
- **Liabilities and insurance:** Who provides necessary insurance coverage?
- **Licenses or certifications:** Are they needed? Does the consultant have them?
- **Additional expenses:** How are unforeseen expenses to be handled? Will you be contacted before these expenses are actually incurred?
- **Work site and space:** Will the consultant need a substantial amount of time on-site? Is there adequate space for the consultant to work while at your company?
- **Confidentiality:** Will the information that the consultant has access to be kept confidential? Are there written assurances to verify this?

Referral Sources

The following associations provide referral services for Minnesota consultants.

Council of Independent
Professional Consultants
Bob Keim 612/633-3393
412 Foshay Tower
821 Marquette Ave.
Minneapolis, MN 55402

Consulting Engineers Council of
Minnesota
David Oxley 612/922-9696
5407 Excelsior Blvd.
Suite A
Minneapolis, MN 55416

You can also refer to:

- Trade associations
- Legal counsel
- Professional associations
- Other companies in your industry
- Regulatory and state agencies
- Yellow Pages
- Trade magazines and journals such as *Pollution Engineering*
- *Dun's Consultants Directory* is a reference that provides listings of consultants by area of expertise and location. It is updated annually and available in business reference section of public libraries.
- *How to Select and Manage Consultants*, Shenson, H.L., C.M.C.; Lexington Books, 1990.
- *Handbook of Management Consulting Services*, Barcus, S.W., McGraw-Hill, 1986.