INSTALLATION
OPERATION
MAINTENANCE

DO NOT STORE GRAY PVC ENFORCER IN DIRECT SUNLIGHT

Built to Last

Composite Mesh Pad (CMP) Dry Scrubber Enforcer III™

Enforcer III™

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JOB NO: _____

CUSTOMER: _____

APPLICATION: _____

Midwest Air Products Co., Inc.

INDEX

CAUTION

This equipment can cause serious bodily injury. Severe damage could occur to the equipment, surrounding property and automobiles. Before operating this equipment read the Installation, Operation and Maintenance Instructions.

This unit will malfunction If:

1. Spray nozzles become plugged.
2. Re-circulation system is not operating properly.
3. Washdown schedule is not maintained.
4. Mesh pads are loaded with concentrated chrome.
5. Proper velocity is not maintained.
6. Mesh pads are damaged or out of alignment.

Due to the toxic and highly corrosive nature of chromic acid, mechanical re-circulation accessories, plumbing, etc. can and will eventually fail possibly causing a spill. Mapco recommends secondary containment for chrome scrubber, re-circulation system, supply and waste plumbing.

1. Open access door and check all mesh pads for separation between scrubber side wall and or mesh pad retainer. Also check mesh pad for voids or deterioration. Any opening or gap in mesh pad could allow mists to bypass mesh pads.
2. Plumbing - Make sure all plumbing is installed to code. Check for leaks.
3. Fresh water make-up - Make sure the proper amount of fresh water make-up is supplied on a regular basis to the re-circulation system or Enforcer III ™ to avoid concentration of scrubber liquor.
4. Blown-down - make sure re-circulation system is purged regularly to avoid concentration of scrubber liquor.
5. Velocity/CFM - External static pressure for the purposed system has been estimated and may vary depending on actual field conditions. Make sure exhaust fan is exhausting proper volume (CFM). Deviation from design could cause excessive misting at mist eliminator.
6. Spray Pattern - check spray nozzles upon start-up for good spray pattern. Debris lodged in filter media could become dislodged during transit. Without a filtering device, debris could become lodged in spray nozzle causing little or no flow.

Responsible personnel must be assigned to the installation, operation and maintenance of this unit. Read complete manual prior to operating this unit. Observer fan discharge stack immediately after start-up and on a regular basis thereafter. If excessive misting is present, shutdown system immediately and notify MAPCO. Serious damage could occur to property if unit is run under this condition.

Safe operation of this equipment is dependent upon proper operation and regular maintenance. The items listed below should be checked prior to operating this unit and on a regular basis thereafter.

Start-Up Service:

In addition to this installation, operation and maintenance manual, MAPCO offers a factory trained service representative to perform, assist or advise in the installation and start-up of this equipment. The cost for this service is charged per man at the following rates:

A. First eight (8) hours of a single day	**Call Mapco for current Service rates.**
B. Overtime hours in a single day	**Call Mapco for current Service rates.**
C. Sunday or Holiday	**Call Mapco for current Service rates.**

D. Other expenses such as airfare, hotel, car rental, meals, parts, tax, freight, etc. if applicable will be charged at cost plus 15% administration fee.

E. Company Vehicles

1. Company car or truck @ $.75/mile
2. Company truck and trailer @ $1.75/mile

Note: MAPCO assumes the "End User" is knowledgeable of this equipment and fully understands the risks associated with the installation, operation and maintenance of the equipment purchased.

INTRODUCTION - The performance of every MAPCO dry scrubber depends on many factors. The purpose of this manual is to make you aware of these factors so you will obtain the utmost efficient and dependable performance from your MAPCO equipment.

Providing, care is exercised in installing this equipment, and it is given reasonable maintenance, you can be assured of trouble free operation for years to come.

It is important that you study this manual prior to installing and operating this equipment to assure safe installation and operation.

SAFETY - The very nature of air handling equipment and accessories present a hazard to personnel during installation and maintenance. The following precautions should be observed prior to starting and maintaining the scrubber:

1. Inspect the name plate or other tags for special instructions.
2. All system motors should be locked out. This is accomplished by padlocking the disconnect switch in the off position until installation or maintenance is complete.
3. The scrubber housing should be inspected for debris or any loose parts.
4. Installation should be complete with inlet and outlet accessories attached.
5. All guards should be in place and secured. Never remove or replace any guards unless pump is shutdown and locked out.
6. All dampers in duct system should be locked in open position.
7. Never discharge corrosive or harmful fumes from the fan. Fume Scrubber should always be operated with the proper amount of water.
8. Inspect ductwork for leakage of harmful or corrosive fumes.
9. Follow good safety practices when installing or maintaining this equipment.

RECEIVING AND INSPECTION - Upon receipt of shipment, check first to see that all items on bill of lading and/or packing slip have been received. By careful inspection determine whether damage has occurred in transit. Any shortage or damage should be noted and a claim should be filed immediately.

Equipment manufactured by Midwest air Products Co., Inc. has been inspected at our factory in Traverse City, MI.

HANDLING AND STORAGE - If installation of the scrubber is delayed and storage is made outdoors, provide reasonable weather protection. Special attention should be given to pump and motor to prevent the entrance of water. When transporting or installing a scrubber, the lifting eyes should be used to prevent damage.

Never pick a scrubber up by its flanges. Do not tarp equipment or ductwork exposed to direct sun-light. Excessive heat can build-up causing distortion. Motors and pumps supplied with products manufactured by Midwest Air Products Co., Inc. have been test run prior to shipping. All scrubbers have been test run and checked for leaks.

FOUNDATIONS - A rigid, level foundation is vitally essential for operation and good performance of a scrubber. A frequent error is to design a foundation for the weight of the scrubber only. Consideration should be given for weight of the scrubbing liquor.

Poured concrete is preferred to steel or wood. Steel platforms should be heavily braced.

DUCT CONNECTIONS - Duct loads can cause distortion with consequent damage to the scrubber. With this is mind, please observe the following:

1. Support ducts independently of scrubber.

2. Use flexible connections between fan and scrubber.

3. Inlet duct should be supplied with a flanged connection a minimum of 3'-0" from scrubber inlet.

OPERATING TEMPERATURES - The dry scrubber is fabricated from 3/8" thick type I extruded PVC. If process runs a constant temperature exceeding 130^{o} F, other materials should be used.

MATERIALS OF CONSTRUCTION - MAPCO
Dry scrubber shells are fabricated from 3/8" Type I, grade I corrosion resistant, unplasticized PVC. Inlet and outlet flanges are 3/4" thick (when both inlet and outlet are square or rectangular). It is recommended that all chrome control equipment be set up with some form of secondary containment should a leak occur.

GENERAL
1. Prior to installing this equipment inspect the name plates or other tags for special instructions.

2. It is recommended that this equipment be installed by personnel familiar with the installation of this type of equipment.

3. All MAPCO Fume Scrubbers are supplied with an enamel coated steel base. If the scrubber is mounted on a platform, it should be thoroughly braced. If the scrubber is roof mounted, a structural engineer should be consulted to determine if the roof can support the operating weight of the scrubber. This equipment is constructed of P.V.C., Polypropylene or F.R.P. Care should be exercised in handling this equipment during installation to prevent damage caused by external stress or shock.

INSTALLATION INSTRUCTIONS

1. Prior to installation, inspect mesh pads for damage during transit. Inspection can be made by looking through the clear inspection doors with the aid of a flashlight. If media is separated from sidewall, consult factory immediately. **DO NOT RUN THE UNIT**.

2. Inspect the interior for debris prior to connecting inlet/outlet transitions, duct, supply and waste plumbing.

3. Inspect all plumbing connections for breakage or leaks.

4. All MAPCO scrubbers are equipped with lifting eyes for rigging. Do not lift P.V.C. scrubbers by the flanges use lifting eyes.

5. It is recommended that inlet/outlet transitions be bolted on prior to setting the scrubber. Prior to bolting transitions be sure the flanges are clean. Use adhesive backed, closed cell gasket or 100% silicone caulking material supplied with the scrubber. Apply gasket starting at the center of the top flange horizontally. Continue around face of flange to starting point making sure gasket is within the inside of bolt holes. Bolt transitions in place using stainless steel hardware supplied with unit. Bolt holes (if not drilled) should be on 4" or 6" centerlines.

6. After transitions are installed and bolts tightened, working inside the scrubber, apply a sufficient amount of compatible caulking along the bottom at the flange joint and up both sides of inlet and outlet. This method applies for transitions bolted in the horizontal position. Using a putty knife, smooth out the caulking to be sure the joint is completely sealed. This is a precautionary step only. Mapco scrubbers are supplied with 3/4" thick inlet and outlet flanges to promote a good seal and minimize leakage.

7. Install unit on a solid base or platform. Make sure the scrubber is sufficiently elevated to allow effluent to flow back to holding tank or waste treatment.

SUPPLY PIPING - Follow proper plumbing codes when installing plumbing. Double wall containment may be required. DO NOT tap into potable drinking water for supply of clean water. Use the proper back-flow valves, etc. to prevent cross-contamination.

1. The drain is located in the center of the scrubber bottom (in some cases the drain may be located on the side of the unit). It is good practice to install a valve prior to running the drain line.

2. The supply line should be plumbed using sch. 80 PVC or CPVC as a minimum. Pipe supports should be installed to insure solid installation (see plumbing schematic for supply diameter). In most cases the ENFORCER IIITM is installed inside where it is not subject to freezing. If this is not the case, the supply line must be heat traced to avoid freeze up. If the system was not purchased with a re-circulation system and pumps are to be used for supply, a check valve should be used on the pump discharge and/or pump suction.

3. The re-circulation tank overflow and drain should be plumbed to waste treatment. Install a shut-off valve after drain and prior to overflow if both lines are plumbed to the same line.

4. In order to minimize plugging of the spray nozzles, a filtering device should be installed on the pump discharge of the supply pump to catch any debris. It is good practice to do the same on the pump suction. If not installed, the nozzles will eventually become plugged and cause the mesh pads to plug. This could create undue stress on the mesh pads and allow chrome to bypass the system.

RECIRCULATION SYSTEMS (optional) -Because every application is unique, MAPCO offers several distinct re-circulation packages. Depending on how your system was configured and what you purchased, one of the following descriptions should apply. All re-circulation systems can be purchased with an (optional) control package for automated operation.

OPERATION IMPORTANT - The polypropylene mesh pads supplied with this unit may contain residual lubricating oil that is used on the knitting needles during pad construction. Mapco knows of no instance where these oils presented a problem involving contamination of the plating bath. To avoid any possibility of plating bath contamination, effluent from initial pad washdowns should be sent to waste treatment until foamy brown traces of oil disappear.

Inadequate washdown procedures and/ or excessively high concentrations of chrome may considerably shorten the service life of polypropylene mesh pads. This is especially true for the first phase mesh pad. Mapco offers a more expensive alternate mesh pad constructed of Kynar®. Kynar® offers a higher degree of resistance to chromic acid and should significantly increase the life expectancy of the first phase pad. These pads are offered as an option and are not standard equipment. Replacement Kynar® mesh pads cost run three to five times that of polypropylene.

PRE-FILTER - The ENFORCER III™ is designed to operate with either an in-line mist eliminator, a mesh pad installed in the exhaust hood (Terminator™ fume hood), or an additional pre-filter mesh pad section incorporated directly into the lower section of the ENFORCER III ™ shell. In all cases, this pre-filter acts as a coalescer to remove large droplets of chromic acid from the air stream before the air enters the ENFORCER. Due to the high loading of the pre-filter, it will require the most washdown cycles. When washed down, the chrome effluent should be directed back to the plating tank or a holding tank.

ENFORCER III™ WASHDOWN SCHEDULE (FREQUENCY AND DURATION)

The ENFORCER III ™ is designed with three stages (four if the pre-filter is incorporated within the ENFORCER III™). The first stage is directly above the inlet. The second and third (optional fourth) stages are directly above the first. As the air passes through each stage a percentage of chrome is removed. The first stage will collect the highest percentage of larger chrome droplets and therefore will require more washdown cycles. The last stage will require the least amount of washdown cycles. through each stage a percentage of chrome is removed. The first stage will collect the highest percentage of larger chrome droplets and therefore will require more washdown cycles. The last stage will require the least amount of washdown cycles

PHASE I WASHDOWN - The pre-filter (first stage), in most cases will require a washdown every two to three hours. The duration of the washdown will last from 30 - 45 seconds. This can be determined by visual inspection of the effluent. When the water is clean the washdown duration will be established.

PHASE II WASHDOWN - The second stage will require a washdown every three to four hours. The duration of the washdown will last from 30 - 45 seconds. This can be determined by visual inspection of the effluent. When the water is clean the washdown duration will be established.

PHASE III WASHDOWN - The third stage will require a washdown every four to eight hours. The duration of the washdown will last from 15 - 30 seconds. This can be determined by visual inspection of the effluent. When the water is clean the washdown duration will be established.

PHASE IV WASHDOWN (optional) - The fourth stage will require a washdown once a day. The duration of the washdown will last from 15 - 30 seconds. This can be determined by visual inspection of the effluent. When the water is clean the washdown duration will be established.

Proper washdown of the mesh pad will be indicated when effluent produced from washdown runs clear at the end of the wash cycle. For situations involving very light loadings of chromic acid, it may be possible to decrease washdown frequency and/or duration. Concentrated effluent will indicate the need for more frequent or longer duration washdown of the mesh pad.

START-UP - After starting the unit and making all adjustments to the exhaust system it is important that you document the initial pressure drop as indicated on the magnehelic or photohelic gauge located on the side of the Enforcer IIITM or control panel. The reading recorded will be the proper static pressure this unit should operate under. Any deviation in this measurement will indicate a potential problem with the system.

PREVENTATIVE MAINTENANCE - The ENFORCER requires minimal maintenance when operated and maintained according to instructions. Until you have run this equipment for a few months and are totally familiar with its operation, Mapco recommends you perform the following inspections on a weekly or bi-weekly basis. When you have a good grasp on how the system functions, the inspections can be made during scheduled down time. Mapco recommends quarterly inspections as a minimum.

NOTE: Use the appropriate safety equipment, clothing and eye protection. Follow manufacturers recommended safety procedures for safe handling of all chemicals and other potential hazards.

A. SPRAY NOZZLES - Spray nozzles should be visually checked for proper spray pattern. The spray pattern should give the appearance of a full cone for each nozzle. If the pattern appears to be erratic, the spray header and nozzle assembly should be removed from the unit and cleaned. Improper or no spray can cause severe plugging and deterioration of the mesh pads. Mapco recommends the use of a strainer in the main header line to minimize nozzle plug-ging.

1. Shut off water supply to spray header. Shut system down and lockout all electrical panels, switches or disconnects. Follow proper safety procedures to insure against header discharge while working on spray header.

2. Remove bolts securing header flange to sidewall of scrubber. Break apart union connection at main spray header. Take all necessary precautions to avoid spillage of solution. Spray nozzles typically point up, rotate header 180^0 to allow drainage. Be sure solution has completely drained from header. Pry header away from backing plate. Exercise caution to avoid breaking header flange when removing or prying. Remove header from unit.

3. Remove threaded end cap and all spray nozzles from spray header. Remove all debris from nozzles and header.

4. Reverse above steps and re-install. Make sure header flange and backing plate are secured and leak proof. Mapco recommends the use of a 100% silicone caulking and /or Teflon gasket.

B. MESH PAD FILTER MEDIA

Mesh pads should be checked for plugging, build-up or separation from retainer. Under normal circumstances, the mesh pad filter media requires minimal maintenance, provided, the spray nozzles, washdown schedule, and washdown concentration are maintained. Other factors that may accelerate plugging are minerals in the washdown liquor such as calcium or small dust particles present in the plant air from grinding operations, etc. Should the unit be operated for periods without water, or fine particles are present in the plant air, the mesh pads will eventually plug and/or deteriorate. If mesh pad becomes plugged, remove and clean.

1. Shut system down and lockout all electrical panels, switches or disconnects. Follow proper safety procedures.

2. Rinse pads thoroughly with clean water.

3. Remove stainless steel bolts holding mesh pad access doors to unit. In some cases doors are sealed with caulking which could cause door to stick to frame. With a pry bar, gently pry on door and remove slowly. Excess pressure will break door.

4. Grasp mesh pad retainer through finger holes or handles and gently pull. Depending on retainer size it may be necessary to utilize other equipment or additional man power to remove pad.

5. Rinse pad in rinse tank or clean with high pressure hose. Wear proper safety equipment and follow proper procedure for chemicals involved. Make certain pad has not deteriorated, plugged or pulled away from retainer frame. Check for holes in pad.

6. After pad is thoroughly cleaned, gently slide retainer back into unit. When all pads are replaced apply 100% silicone caulking to outward side of backing flange bolt holes. Check for gap between retainer and access door. If a gap is present, apply caulking or gasket to fill void. Apply 100% silicone caulking to inward side of bolt holes and allow to skin over. Apply door making sure alignment marks are lined up. Make sure all bolts are started prior to tightening bolts. Do not over tighten bolts.

IMPORTANT NOTE: Mesh pads do not last forever and replacement is inevitable. Under no circumstances does Mapco recommend or approve of mesh pads being installed by other.

If mesh pads are installed by other than Mapco personnel, Mapco shall in no event be liable for incidental or consequential damages, nor for special damages resulting from improper installation of mesh pads.

RECOMMENDED SPARE PARTS - Sooner or later something is going to wear out or fail. When your ventilation system is down your process usually goes with it. Too often we see our customers spending premium dollars to expedite replacement parts to get their line running. Most associated parts of your chrome scrubber and/or fan can be shipped within a few days to a week. The following spare parts require longer than usual lead time:

1. Mesh pads and retainers

2. Fan wheel and shaft

These parts are typically long lead items (three to six weeks) that may require an extended shut-down period should they fail.

Mapco strongly recommends that these parts be carried in your inventory of spare parts.

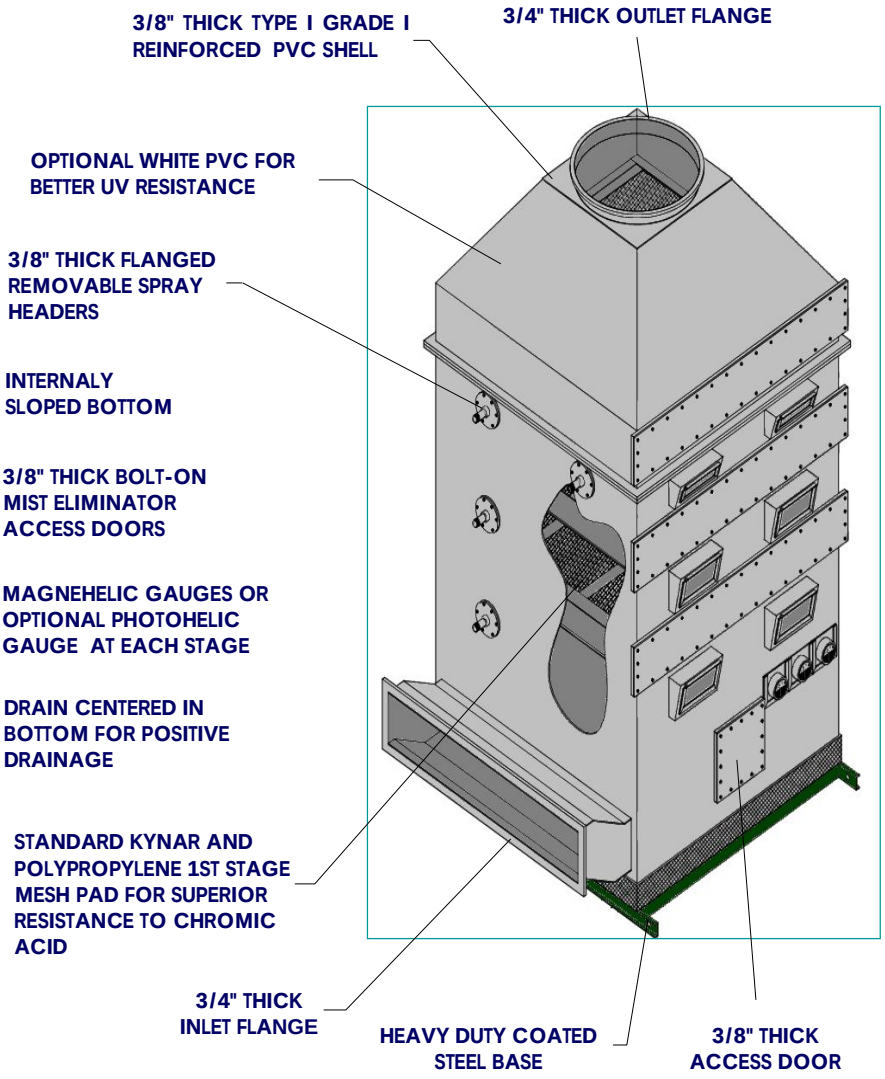
SCRUBBER TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSE
POOR SPRAY PATTERN	• Spray Nozzles plugged up • Spray Headers plugged up • Pump suction blocked • Pump discharge piping too small • Insufficient water in sump • Pump running backwards • Total head exceeds that of pump
SCRUBBER WILL NOT DRAIN	• Drain line to remote tank is not submerged or trapped • Drain line is not sloped towards tank • Drain line plugged • Drain line too small
MOISTURE AFTER UNIT	• Re-Entrainment due to liquid loading • Gap or void in mist eliminator • Mist Eliminator damaged • Velocity too high through scrubber • Droplet size too small • Build-up of chrome on Mist Eliminator • Mesh pad mist eliminator plugged or saturated—liquid loading too high—throttle back nozzle spray pattern—clean mesh pad
LOW REMOVAL EFFICIENCY	• Insufficient or no water to spray nozzles • Mist Eliminator plugged or shifted • Velocity too high or too low • Inlet concentration too high
DECREASED EXHAUST VOLUME—EXHAUST SYSTEM NOT VENTING PROPERLY	• Check fan—RPM—belts—rotation—fuses • Insufficient air make-up in building • Dampers closed or broken in closed position • Ductwork plugged with solids • High negative pressure in building • Leaks in ductwork • System static pressure too high
OILY SOLUTION IN PLATING BATH	• Residual oils used in manufacture of mesh pads. Run several washdown cycles on each phase until clean.
DETERIORATION OF MESH PAD	• No water to spray nozzles • Spray nozzles plugged • Concentrated chrome build-up • Chrome bath includes chemicals not compatible with chrome

Due to the high efficiency of composite mesh pads, plugging can occur from the following sources:

1. Grinding dust.
2. Minerals deposit from water supply.
3. Flux from soldering or welding process.

Enforcer III



Enforcer III™
WASHDOWN SCHEDULE
24 hour day

STAGE	DELIVERY GPM	FREQUENCY	DURATION (seconds)	GALLONS (per cycle)	GALLONS (per day)	HEADER SIZE
STAGE 1						
STAGE 2						
STAGE 3						

MIST ELIMINATOR

STAGE 1						
STAGE 2						

Notes:

TERMINATOR EXHAUST HOOD

STATION (S)	DELIVERY GPM	FREQUENCY	DURATION (SECONDS)	GALLONS (PER CYCLE)	GALLONS (PER DAY)	HEADER SIZE

Enforcer III™

Wash Down Program Form

24 Hour Day

TIME	CHANNEL 1	CHANNEL 2	CHANNEL 3	CHANNEL 4

Highest Value Exhaust and Pollution Control Equipment

“old school quality, old school service”

Corrosion Resistant PVC Duct
Corzan™ Duct
Fiberglass Overlaid Duct

Turnkey Installations

Corzan™ Duct

Motorized Dampers

Terminator™ Composite Mesh Pad Exhaust Hoods