Chapter 7

WASTEWATER

7

This chapter provides ordinance, policy, and standards establishing design criteria for constructing and modifying water systems to be owned and operated by the city. It provides guidance on agreements, design report preparation, transmission and distribution systems, fire protection and final plans preparation.

7-1.002 ADEQ REQUIREMENTS

A. Design Policy

Maricopa County Environmental Services Department (MCESD) is required to review and approve all public sanitary sewer line extensions and construction of wastewater-related facilities within the city's service area, prior to the city approving the final plans.

Engineering Bulletin No. 10, "Guidelines for the Construction of Water Systems" published by the Arizona Department of Environmental Quality (ADEQ) and Arizona Administrative Code, "Title18 - Environmental Quality," contain specific requirements for submittals, approvals and notifications when extension of a public sanitary sewer line is proposed. Some of the provisions are outlined below. The developer is responsible for reading and complying with all regulations and requirements.

1. Before Plan Review approves final plans, the developer will submit a cover sheet for the improvement plans with a completed signature and date of approval from the MCESD. The city's Water Resources engineer accepting the sewer design report will provide a letter to comply with the requirements of Arizona Administrative Code Section R18-9-E301.
2. Before commencing construction, the contractor or developer will provide documentation to the city public works inspector that a Certificate of Approval to Construct and/or Provisional Verification of General Permit Conformance has been approved by MCESD.
3. Before building permits are issued, the developer will submit to the city public works inspector a Certificate of Approval of Construction and/or Verification of General Permit Conformance signed by MCESD.
4. Before Inspection Services issues a Letter of Acceptance, the developer will deliver to the city's Public Works Inspector an acceptable set of full-size 4-mil as-built mylars of the improvements.

7-1.003 PRIVATE WASTEWATER COMPANIES

Portions of Scottsdale's municipal service area are served by private wastewater companies. Figure 7.1-1 delineates these areas.

Placing private sanitary sewer lines within city rights-of-way (ROW) will require an agreement between the private wastewater company and the city.

The private company should review modifications or construction of wastewater systems within their franchise areas. When submitting final plans, the developer must provide written documentation that the private wastewater company has reviewed and approved the sanitary sewer lines within its jurisdiction.

The city cannot provide wastewater service within private wastewater company franchise areas and will not review private wastewater systems unless requested by the owner or for work that is to occur within the city's ROW. In cases where the city is requested to review private wastewater systems, the applicable review fees must be paid. A note must be placed on the drawings stating operation and maintenance responsibilities.

7-1.100 AGREEMENTS

Developers and property owners who install improvements to the public wastewater system may be eligible to request a credit, oversize or payback agreement with the city allowing for partial reimbursement of costs to design and construct those improvements.

A. Ordinance Requirements

Developers who construct wastewater system improvements may receive credit for such construction, see Scottsdale Revised Code, Section 49-74.2. The city has specific programs

to provide for reimbursement agreements with developers or property owners and for the collection of line payback charges and for the oversizing of wastewater lines, see Scottsdale Revised Code, Section 49-212.

CREDIT AGREEMENTS

7-1.101

Credit agreements are established to compensate a developer for installing system infrastructure that has been identified in the city's Capital Improvement Plan (CIP) and/or included in the most recent Development Fees Report. Credit agreements are set up through the Water Resources Department and are to be identified in the developer's master plan.

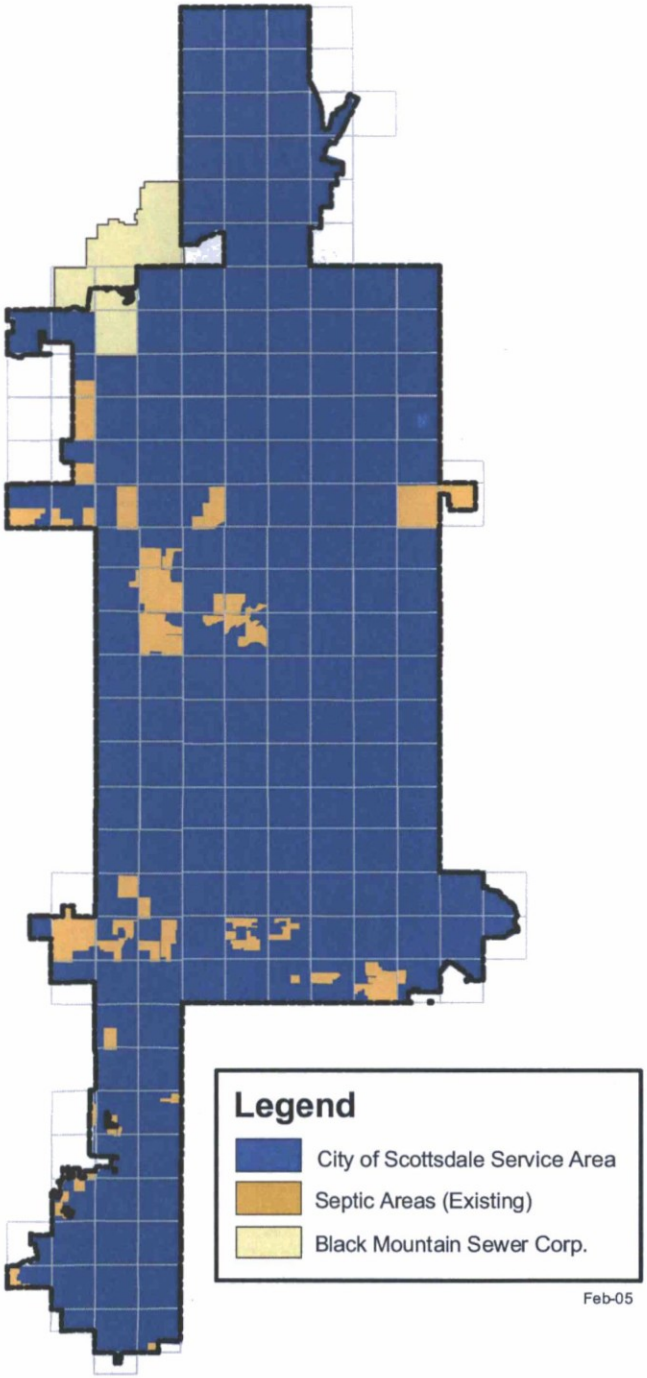


FIGURE 7.1-1 WASTEWATER SERVICE AREAS

7-1.102

OVERSIZE AGREEMENTS

Oversizing Agreements allow the city to compensate developers for the cost to install a sanitary sewer line larger than what is minimally required to serve the development. Oversizing is requested by the Water Resources Department when a larger line is necessary to meet the needs of additional properties upstream of a development. All oversizing projects involving city funds must have an oversizing agreement and must meet all the city

requirements prior to plan approval and construction. The city can only participate in the cost of oversizing when there are sufficient funds in the CIP budget and the amount does not exceed the limitations set forth by the Arizona Revised Statutes, Title 34, Article 2, Paragraph 201.D. If sufficient funds do not exist, the oversized lines will be installed at the developer's cost. Oversizing agreements are set up through the Water Resources Department.

PAYBACK AGREEMENTS

7-1.103

Developers may request a Payback Agreement when constructing sanitary sewer lines across frontages of parcels not currently receiving wastewater service from the city. When a designated parcel requests wastewater service, a pro-rated cost of the sanitary sewer line is collected by the city and returned to the developer. Line extension payback agreements are set up through the Water Resources Department. For questions or details on procedures to initiate an agreement, contact the Water Resources Department. The Extension Participation Program (see www.ScottsdaleAZ.gov/bldgresources/counterresources/waterfeepacket/ExtensionParticipation) may be available to single family property owners required to public extended public sewer lines to their lot for service.

WASTEWATER SERVICE AGREEMENT

7-1.104

The county's Sewer Service Agreement is to be completed by the engineer and submitted with the final plans to the One Stop Shop. Plan Review will sign the water and wastewater portions of the agreement and Solid Waste Management staff will sign for the refuse service. It is the owner's responsibility to obtain these signatures from the respective city divisions. The agreements will not be signed prior to the city approving the final plans. Following is specific information regarding the city's municipal wastewater system and the appropriate identification numbers:

- Water Campus – Wastewater Treatment # 37-024
- Gainey Ranch – Wastewater Treatment # 37-160
- System Name: City of Scottsdale Water Campus
- Address: 8787 E. Hualapai Dr., Scottsdale, AZ 85255

The following identification number relates directly to that portion of the city's wastewater system that is not treated at the Water Campus or Gainey Ranch. This area is generally south of Doubletree at Scottsdale Road, south of Via Linda at Pima Road and excludes the Hayden corridor to Frank Lloyd Wright Blvd:

- General sanitary sewer collection system # 37-011

The city's Wastewater System Master Plan is helpful in determining the appropriate system identification facility number.

DESIGN REPORTS

7-1.200

Wastewater master plans and basis of design reports provide an analysis of the impact that a development will have on the city's wastewater system. These reports are reviewed and accepted by the Water Resources Department and then utilized by Plan Review to verify the infrastructure to be constructed. Accepted design reports are retained in the Records Division and are made available to developers and engineers upon request.

A. Design Policy

Analysis of all proposed development, determined by the city to have an impact on the wastewater system, needs to be performed by a civil engineer registered in the State of Arizona. The analysis needs to include the effects of peak flow to ensure proper sizing and layout of the proposed wastewater system facilities.

A wastewater master plan or a wastewater basis of design report may be required for each development within the city when an extension of the system is necessary or the proposed development will produce more than 10,000 gallons of wastewater per day. Water Resources staff will determine which report is appropriate for a given development and convey this requirement to the city's project coordinator for inclusion in the case's stipulations. Reports will be separately submitted for review to the One Stop Shop, directed to the attention of the Water Resources Department. The reports must be accepted by the Water Resources Department prior to the submittal of final plans for review by Plan Review, unless otherwise agreed to by Plan Review staff.

7-1.201 WASTEWATER MASTER PLAN

A wastewater master plan is required when a change in the existing zoning or land use is proposed, phased construction is proposed or when the Water Resources Department determines. The Wastewater System Master Plan must show compliance with the city's design criteria and development policies for each phase of the project and to establish a skeletal system for the phased development of a master planned project.

7-1.202 WASTEWATER BASIS OF DESIGN REPORT

Most projects within the city will require a Basis of Design Report. The objectives of a basis of design report are to determine the development's wastewater demand, analyze the hydraulics of the proposed sanitary sewer system to a point evaluated by the city's Wastewater System Master Plan and demonstrate conformance for each phase of the development with the accepted master plan for that development.

7-1.203 GENERAL REPORT REQUIREMENTS

All reports submitted to the city for review must be prepared in accordance with the guidelines listed below.

A. General format

1. The report should be on letter-sized paper (8 ½ x 11).
2. All reports will have a table of contents.
3. Maps and other supporting materials larger than folded ledger size paper (11 x 17) should be placed into sleeves providing an appendix to the report.
4. A civil engineer licensed to practice in the State of Arizona must seal each report.

B. Report cover

1. Covers should consist of cardstock paper or better.
2. The project name should be located on the cover.
3. The names, addresses and phone numbers of the developer/owner and engineer should be stated on the cover.
4. The original submittal and any subsequent revision dates should be located on the cover.

C. Vicinity map

Identify the project's location with respect to major cross streets.

7-1.204 WASTEWATER BASIS OF DESIGN REPORT CONTENT

A. Introduction

Summarize the proposed development:

1. Include a legal description based on sectional breakdown or reference within a platted development.
2. Describe the existing and proposed site zoning and land uses.

3. Include reference to elements of the city's General Plan and identify any designated character area or studies that will affect the project's design.

B. Design Documentation

Note compliance with this manual and all other applicable standards and codes on the Design Report.

1. Include a discussion of which design procedures, policies and methodologies will be incorporated into the design engineering of the wastewater system.
2. List the title and version of any software used in the design analysis.

C. Existing Conditions

1. State the existing zoning and land use.
2. Describe the existing, topography, vegetation and landform features.
3. Include the location and description of existing utilities in the vicinity.
4. Reference any existing master plans or design reports applicable to adjacent development.
5. Indicate the results of any certified flow testing of the existing system.

D. Proposed Conditions

1. Include a site plan that indicates the layout of the proposed development.
2. Describe the proposed connection(s) to the city's wastewater system. Show extension of sanitary sewer lines into the site.
3. Address maintenance responsibilities of the proposed wastewater system.

E. Computations

1. Base wastewater flows on the design flows in this manual.
2. Verify any variance from the stated design flows with the Water Resources Department.
3. Give particular attention to wastewater peaking factors used for restaurants or specialty developments.
4. Use scour analysis where surface runoff exceeds 500 cubic feet per second (cfs) over a sanitary sewer pipe.
5. Pipe data - ID, upstream and downstream nodes, invert elevations, pipe material, slope, length, diameter, Manning's n-value, peak flow, flow depth, flow depth/diameter ratio, actual flow velocity, full flow design capacity and average pipe cover.

F. Design Documentation.

1. Common spreadsheet formats shall be compatible with MS® Excel.

G. Summary

1. Provide a summary of the proposed wastewater improvements stating that all city design standards and policies have been met or indicate any variance or exception. Note why the developer is requesting any variance or exception.
2. Include a brief project schedule indicating the proposed start and completion of the development's improvements.

H. Supporting Maps

Include a scaled site plan showing all existing and proposed utility lines and surface improvements.

1. Graphics should screen the development's background, present existing utilities as dashed lines and proposed utilities as bold solid lines.

2. Screen existing topography into the background. Clearly label, at 2-foot intervals, all existing and proposed contour intervals. Show sufficient information to evaluate pipe cover.
3. Show, dimension and label clearly all property lines, rights-of-way, tract and easement lines.

I. Miscellaneous

Requests for more specific information regarding report requirements and the wastewater system may be obtained by contacting the Water Resources Department.

7-1.205 WASTEWATER MASTER PLAN REPORT CONTENT

1. The Wastewater Master Plan Report will specify the terms and requirements for wastewater service to the development.
2. All development projects will be responsible for determining their specific wastewater discharge and will include flow from any upstream developments to ensure the system is designed properly.
3. If the proposed development requires a change in zoning, which increases density or proposes a wastewater system different from the city's existing Wastewater System Master Plan, then additional off-site calculations will be required.
4. Flows will be calculated according to this section.
5. A computer disk containing all calculations will be submitted along with the Master Plan report.
6. Each Master Plan map must show the following:
   a. All proposed on-site and off-site facilities including, but not limited to, lift stations, trunk lines and collection lines.
   b. Proposed street locations, parcel boundaries and proposed lots within each parcel.
   c. Contour lines at 2-foot intervals showing the elevation of the land surface.
   d. A separate area location map showing existing and proposed streets, as well as existing parcels surrounding the project to a distance of 1 mile from the exterior boundaries of the project. Assessor's maps can provide the information required to prepare these composite maps.
   e. A scale that is sufficient to show all required information clearly.
7. All sanitary sewer lines that cross golf courses or other open areas must do so within established roads. If dedicated roads are not practical, then the crossing must be within a 20-foot-wide accessible easement within a tract. No walls may cross these easements.
8. The Wastewater Master Plan must show compliance to construct sanitary sewer lines, if not already in place, across all dedicated frontages of the development where future extension is possible.
9. A construction schedule will be included in a table format for all wastewater related construction required to serve the development. The schedule will have each phase or parcel as column headings and each construction project or system component as rights-of-way (ROW) headings. A mark in each box will specify when each constructed item will be required for each phase of the development.
10. The master plan report must comply with the adopted city Wastewater System Master Plan encompassing the respective area.
11. Those Master Planned Developments that design a wastewater collection system that will be phased will provide a description of the phasing.

For specific information regarding wastewater plan requirements and/or the city's current Wastewater Integrated Master Plan, contact the Water Resources Department.

WASTEWATER FACILITIES 7-1.300

Lift stations and force mains are typically designed and constructed by the city through its Capital Improvement Program. Developers needing to construct these facilities must contact the Water Resources Department and request a meeting. The developer should be prepared to address how the proposed system will conform to the city's Wastewater System Master Plan. The city will address design issues, the city's review process for wastewater facilities and any potential city cost participation.

A. Ordinance Requirements

When wastewater service is not available, a septic system or alternative system acceptable to the Water Resources Department may be allowed with the approval of both the City of Scottsdale and the Maricopa County Environmental Services Department, Section 49-116.

B. Design Policy

Maricopa County Environmental Services Department and the city discourage the development of privately owned packaged treatment facilities designed to serve two or more lots.

Where lift stations are necessary, the engineer will meet with the Water Resources Department to discuss design requirements, ownership and maintenance responsibilities.

SEPTIC SYSTEMS / ON-SITE TREATMENT FACILITIES 7-1.301

The property owner is responsible for the design, construction, operation and maintenance of septic systems / on-site wastewater treatment facilities. The city will not accept any type of on-site system for operation and maintenance.

All on-site wastewater treatment facilities will be designed and constructed compliant with the applicable requirements of the Maricopa County Environmental Services Department. Final plans submitted to the One Stop Shop will include the county's permit number for the on-site system.

WASTEWATER LIFT STATIONS 7-1.302

Water Operations maintains a separate document outlining the design, specifications and materials required for a city owned and maintained wastewater lift station. This document may be viewed at www.ScottsdaleAZ.gov/bldgresources/counterresources/WaterFeePacket. Contact the Water Resources Department for additional information.

A. Site Selection

In selecting a site for a sewage lift station, consider accessibility, drainage patterns, visual impact, function and design constraints.

Consider the potential for flooding when selecting a pump station location. The station's equipment must be protected from damage and remain operable during a 100-year flood.

Unless otherwise agreed to in writing by the city's Rights-of-Way Agent, each tract or lot dedicated to the city will be conveyed by a general warranty deed and accompanied by a title policy in favor of the city, both to the satisfaction of the city.

B. Lift Station Design

Arizona Administrative Code, Title 18, Chapter 9, "Water Pollution Control," contains minimum requirements for a wastewater lift station. Additional requirements specific to the city must be obtained from the Water Resources Department before beginning design. At a minimum, telemetry, dual pumps, backup power supply, three-phase power, odor control and perimeter walls will be required. The site will also be large enough to contain all the equipment and service equipment for repairs.

Prior to the preparation of construction drawings, a preliminary design report will be prepared and submitted to the One Stop Shop for Water Resources Department review. The preliminary report will outline the type of equipment and controls proposed for the station. A final design report prepared by a registered professional engineer, licensed in the State of Arizona, must accompany all pump station design drawings and specifications submitted to the city for review.

7-1.303 FORCE MAINS

Force mains will be located within a rights-of-way, private street tract or utility easement. The line must be located under pavement where possible.

A. Velocity Requirements

The flow velocity in the force main must be between 4 and 6 feet per second (fps).

B. Materials of Construction

All pipe material used in design of the force mains must have established ASTM, ANSI, AWWA and NSF standards of manufacture or seals of approval and shall be designated as pressure sanitary sewer pipe. Force mains must be identified as such with marking tape 1 foot above the pipe. All ductile iron force mains shall be lined.

C. Air Release Valves

Air release valves designed for sewage must be provided on force mains at all peaks in elevation see COS Standard Detail No. 2405, www.ScottsdaleAZ.gov/design/COSMAGSupp.

D. Cleanouts

Two-way cleanouts shall be provided every 1,300 feet apart or 1-way cleanouts every 650 feet. Single cleanouts must be provided at all horizontal bends oriented in line with the downstream pipe. See COS Standard Detail No. 2403, www.ScottsdaleAZ.gov/design/COSMAGSupp.

E. Force Mains

Force mains will be constructed of restrained ductile iron pipe for the following conditions:

1. All locations where a vertical realignment is required;
2. Drainage wash crossings;
3. Air release assemblies;
4. Clean-out assemblies.

F. Line Separations

1. Where a force main crosses a water main or transmission line, protection must be provided as per ADEQ Engineering Bulletin No. 10 and the Arizona Administrative Code, Title 18, Chapter 9, "Water Pollution Control." At a minimum, the force main should be constructed of ductile iron pipe for a distance of 10 feet on each side of the water line.
2. See COS Standard Detail No. 2402 for details regarding discharge into a manhole from a force main.
3. The minimum separation between the force mains and water lines should be 2 feet wall-to-wall vertically and 6 feet horizontally under all conditions. Where a force main crosses above or less than 6 feet below a water line, the force main shall be encased in at least 6 inches of concrete for 10 feet on either side of the water line. Fittings should not fall within the encasement.

The engineer must evaluate the potential for odor to develop from a force main downstream of the receiving manhole. One-way valves on building service lines shall be specified where there is potential for gasses to strip from the waste stream. The valves should be located at or near the building cleanout and include provisions for access and maintenance by the property owner.

7-1.401

MATERIALS

In selecting pipe material for sanitary sewer lines, give consideration to chemical characteristics of wastewater, especially industrial wastes. Consider velocity; the possibility of septicity; external and internal pipeline forces and preventing infiltration; abrasion; and similar type problems.

Use sanitary sewer lines that are vitrified clay pipe (VCP); polyvinyl chloride (PVC) SDR35, up to 15 inches in diameter; PVC (meeting ASTM F679 - T1) between 18 and 27 inches in diameter; or ductile iron pipe (DIP) with approved interior and exterior linings. Submit in writing to the Water Resources Department any requests for consideration of alternative materials.

Note: Do not change pipe material between manholes.

Where standard strength pipe is not structurally sufficient due to external loading, or 4 feet of pipe cover cannot be maintained, submit a written request with supporting calculations to the Water Resources Department for permission to use extra-strength pipe, special bedding specifications, or alternative construction methods. The Water Resources Department must accept the request in writing prior to Plan Review approval of the final plans.

Ensure that all types of pipe material used in design have established ASTM, ANSI or NSF standards of manufacture or seals of approval, and are designated for use with wastewater.

7-1.402

SYSTEM LAYOUT

Generally, sanitary sewer lines constructed along a street grid should be aligned parallel to, and south or west of the street centerline. Lines should not cross the street centerline except in cases where curvilinear roadway alignments are encountered.

Public sanitary sewer lines within commercial, industrial or multi-family developments must be located within drive aisles a minimum of 6 feet from any structure. Public sanitary sewer lines will be located within tracts and/or public utility easements. No private utilities are allowed longitudinally within a public utility easement.

If the horizontal direction, slope, material or size of the sanitary sewer line changes, a manhole must be constructed. The horizontal angle formed between the two lines cannot be less than 90 degrees. In sanitary sewer lines that are 12 inches or larger, angles formed must be between 120 and 150 degrees to the downstream pipe for odor control purposes.

Note: Curvilinear sanitary sewer lines will not be allowed. Wastewater flows that have not been accepted by the city shall not pass through collection systems.

Developments with numerous curved streets will be discussed with the Water Resources Department to decide whether the city will consider a design report with water and sewer layouts in accordance with the following criteria:

1. Water and sanitary sewer lines will be placed under the paved section of the roadway within the area, from back-of-curb to back-of-curb.
2. Sanitary sewer lines must maintain a minimum of 6-feet horizontal clearance to dry utilities per COS Standard Detail No. 2401.
3. Sanitary sewer manholes are to be located at the approximate center of the drive lane.
4. The water line and sanitary sewer line will run parallel to each other, with 9 feet of separation to the pipes' centerline in order to maintain 6 feet of clearance at manholes.
5. Deflections in the sanitary sewer line shall be designed to nominal fitting angles within standard tolerances and will occur at the same locations where the water line is deflected.

See Section 6-1.302 for related water system criteria.

DESIGN FLOWS

7-1.403

A. Residential

Sanitary sewer lines 8 to 12 inches in diameter will be designed using 100 gallons per capita per day (gpcpd) and a peaking factor of 4.

Sanitary sewer lines larger than 12 inches in diameter will be designed using 105 gpcpd and a peaking factor developed from "Harmon's Formula":

$$Q_{max} = Q_{avg} [1+14 / (4+P1/2)]$$

$$P = Population / 1,000$$

Residential densities are to assume 2.5 persons per dwelling unit, apartment or town home.

B. Commercial and Industrial

Wastewater flows for uses other than those listed below shall be based upon known regional or accepted engineering reference sources approved by the Water Resources Department.

AVERAGE DAY SEWER DEMANDS		
Land Use	**Demand**	**Peaking Factor**
Commercial/Retail	0.5 per sq. ft.	3
Office	0.4 per sq. ft.	3
Restaurant	1.2 per sq. ft.	6
High Density Condominium	140 per room	4.5
Resort Hotel (includes site amenities)	380 per room	4.5
School: without cafeteria	30 per student	6
School: with cafeteria	50 per student	6
Cultural	0.1 per sq. ft.	3

FIGURE 7.1-2 AVERAGE DAY SEWER DEMAND IN GALLONS

HYDRAULIC DESIGN

7-1.404

No public sanitary sewer lines will be less than 8 inches in diameter unless permission is received in writing from the Water Resources Department.

Sanitary sewer lines should be designed and constructed to give mean full flow velocities of not less than 2.5 fps, based upon Manning's Formula, using an "*n*" value of 0.013.

Conversely, to prevent abrasion and erosion of the pipe material, the maximum velocity will be limited to 10 fps at estimated peak flow. Where velocities exceed this maximum figure, the line should be constructed of DIP and lined. In no case will velocities greater than 15 fps be allowed.

Actual velocities will be analyzed under peak flow conditions for each reach of pipe.

Generally, the sanitary sewer system will be designed to achieve uniform flow velocities through consistent slopes. Abrupt changes in slope should be evaluated for hydraulic jump.

The depth to diameter (d/D) ratio for gravity sanitary sewer pipes 12 inches in diameter and less should be no greater than 0.65 in the ultimate peak flow condition. The d/D ratio for gravity drains greater than 12 inches diameter should be no greater than 0.70 for the ultimate peak flow condition.

Mitigation of hydrogen sulfide will be analyzed in the design report and be provided for in the design of the system.

7-1.405

MANHOLES AND CLEAN OUTS

Manholes in city streets should be located near the center of the inside traffic lane, rather than on or near the line separating traffic lanes. Manholes should not be located in bike trails, equestrian trails, sidewalks, crosswalks or wash crossings. Manholes are required at all changes of grade, pipe size, pipe material or alignment and at distances not to exceed those shown below:

Pipe Diameter (inches)	**Maximum Manhole** Spacing (feet)
8 – 15	500
18 – 30	600
36 – 60	800
Over 60	1,300

FIGURE 7.1-3 MANHOLE SPACING

A. Manhole Base

Manhole bases are to be cast in place. The flow channel through the manhole should be steel trowel finished to conform in shape and slope to that of the sanitary sewer pipe. The manhole shelf should be brush or broom finished, with a slope of 1 inch per foot. The manhole bottom should be filleted to prevent solids depositions and channeled to ensure satisfactory flow to the lower invert.

B. Manhole Sections and Cones

All manhole sections and cones should be the precast concrete as detailed in the MAG Standard Detail No. 420, deleting the manhole steps and/or cast in anchors for steps, see www.ScottsdaleAZ.gov/design/COSMAGSupp.

C. Manhole Covers

Manhole covers are to be per MAG Standard Detail No. 424 and COS Standard Detail No. 2421, see www.ScottsdaleAZ.gov/design/COSMAGSupp.

D. Manhole Linings

Manholes will be lined or coated at the junction of a force main, when constructed on sanitary sewer lines 15 inches in diameter or larger or in other design situations where corrosive conditions are anticipated. Manholes receiving wastewater from force mains and ejector lines must be lined. Manholes requiring linings or coatings shall be noted on the final plans.

E. Intersecting Lines within Manholes

Manholes are required for all lines intersecting at angles other than 180 degrees, a change in slope, a change in pipe size or a change in pipe material. The manhole must have a minimum 0.10-foot drop across the trough unless otherwise approved by the Water Resources Department. Where pipe size changes through a manhole, the top invert of the upstream pipe(s) will be equal to or higher than the top invert of the downstream pipe. In large trunk lines, inverts at junctions should be designed to maintain the energy gradient across the junction and prevent backflow.

F. Drop Manholes

The difference in invert elevations between inflow and outflow lines shall not exceed one pipe diameter, unless a drop connection is installed. Drop connections shall be in accordance with MAG Standard Detail No. 426*, modified as follows:

- For drops up to and including 5 feet, use Type "A" drop connections.

- For drops greater than 5 feet, use Type "B" drop connections.

The manhole bottom should be filleted to prevent solid deposition.

G. Manholes at Washes and Drainage Areas

Manholes must be protected from storm drainage and flooding conditions. Sanitary sewer lines will not be allowed in washes or drainage areas unless otherwise approved in writing by the Water Resources Department.

When approved by the city, manholes located within washes or drainage areas are to have bolted watertight covers to prevent inflow and the rim elevation should be a minimum of 18 inches above adjacent finish grade, see COS Standard Detail No. 2420*. Design watertight manhole bases, barrels and grade rings and provide structural protection against scour from a 100-year storm flow. This protection may require encasing the entire manhole using sono-tube form material or constructing a monolithic manhole. The manhole should be designed by the engineer to meet the amount of protection as calculated by the flow conditions of the wash. The engineer is responsible to provide a manhole design eliminating infiltration in wash areas.

H. Cleanouts

Cleanouts per MAG Standard Detail No. 441*, may be used in place of manholes at the ends of laterals that cannot be extended and are less than 150 feet in length. Cleanouts are required to allow for maintenance and inspection of the lines. When a sewer line can be extended by others along the same alignment and grade, a cleanout may be permissible beyond 150 feet in length.

Service connections are not allowed at the ends of cleanouts. Service connections should be provided off the sanitary sewer line a minimum of 2 feet downstream of the cleanout.

*Note: For COS and MAG Standard Details, www.ScottsdaleAZ.gov/design/COSMAGSupp.

MONITORING VAULTS AND MANHOLES

7-1.406

A. Monitoring Vaults

The Water Quality Division has sole discretion when to require a developer to install a monitoring vault for testing wastewater flow and composition. Generally, properties in industrial land use/zoned areas with a projected wastewater discharge of 25,000 gallons per day will be required to install a monitoring vault per COS Standard Detail No. 2460*.

*Note: For COS and MAG Standard Details, www.ScottsdaleAZ.gov/design/COSMAGSupp.

B. Monitoring Manholes

The Water Quality Division has sole discretion when to require a developer to install a monitoring manhole. Generally, commercial properties with potential mixed uses, restaurants and developments that will use chemicals or solvents are required to install monitoring manholes.

Monitoring manholes will be constructed per MAG Standard Detail No. 420*, with a straight channel and no taps or bends for 10 feet upstream or downstream or as approved by the Water Resources Department. Design details for monitoring manholes on sanitary sewer lines, 6 inches or larger with a peak flow greater than 40 gallons per minute (gpm), must be approved by the Water Resources Department.

Monitoring vaults and manholes will be located in a minimum 16-foot-wide easement that extends from the manhole to the existing public wastewater system and be designed for access at all times to monitoring crews and vehicles.

PIPE COVER AND SEPARATIONS

7-1.407

Sanitary sewer pipe will be installed at a depth sufficient to ensure gravity drainage of wastewater from each service line and should anticipate the lowest potential finish floor elevation for each building pad.

Pipe design should ensure gravity drainage from the ultimate drainage area and will allow for future extensions of service to adjacent parcels.

In no case will sanitary sewer lines be installed with less than 4 feet of cover over the top of the pipe, unless otherwise approved by the Water Resources Department.

All sanitary sewer lines will be designed to absorb superimposed live loads and backfill overburden without damage to the pipe material and without adversely affecting the hydraulic characteristics of the pipe. The engineer will specify minimum depths of cover to be provided during the construction of roadways or other facilities affecting cover over the line.

A. Separation of Water and Sanitary Sewer lines

Caution should be taken in the design and construction of the sanitary sewer lines to protect all water supplies from wastewater contamination. To minimize the potential of contamination, the engineer must design the horizontal and vertical separation of water and sanitary sewer lines in accordance with Engineering Bulletin No. 10, "Guidelines for the Construction of Water Systems" published by the Arizona Department of Environmental Quality and the Arizona Administrative Code, Title 18, Chapter 9, "Water Pollution Control".

The minimum horizontal distance from a water line to a sanitary sewer line will be 6 feet, wall-to-wall. The minimum vertical clearance of a water line crossing under a sanitary sewer line will be 18 inches. Water lines crossing over a sanitary sewer line should provide 2 feet of minimum vertical separation.

Where conditions prevent adequate vertical separation or where a water line must cross under a sanitary sewer line:

1. Both the water and sewer line will be constructed for ductile iron pipe (minimum Class 350) with restrained joints, or
2. Where the existing water line is other than restrained ductile iron, the water lines shall be replaced with restrained ductile iron pipe per MAG Standard Detail No. 404-2, www.ScottsdaleAZ.gov/design/COSMAGSupp, and/or
3. where the existing or proposed sewer line is other than restrained ductile iron, the sewer line shall be encased in concrete per MAG Standard Detail No. 404-3, www.ScottsdaleAZ.gov/design/COSMAGSupp.

B. Separation from Structures

Sanitary sewer lines will have a minimum of 6 feet of horizontal clearance from any structural footing or substantial improvement. Design will consider any structural load imposed on the pipe.

The Water Resources Department may consider an indemnity agreement where no alternative sewer alignment is possible and surface improvements, including decorative paving or screen walls, are to be located within 6 feet of the sanitary sewer line. If an indemnity agreement is acceptable to the Water Resources Department, boilerplate language for an indemnity agreement will be provided with final plans review.

C. Separation from Other Utilities

For information about separation from other utilities see COS Standard Detail No. 2401, www.ScottsdaleAZ.gov/design/COSMAGSupp.

D. Separation from Storm Drains and Culverts

Sanitary sewer lines crossing less than 2 feet below a storm drain, culvert or under large structures, such as box culverts and bridges, will require the additional protection of a ductile

iron pipe or encasement. Sanitary sewer lines crossing over storm drains and culverts must be a minimum of 1 foot above and be adequately protected.

WASH CROSSINGS

7-1.408

All wash crossings will be constructed using restrained joint Class 350 ductile iron pipe coated per specification. Bury requirements to place sanitary sewer lines under washes or channels will be based upon the 100-year peak design discharge (Q100) in the channel or wash. The minimum depth of bury below the design flow line of the channel or wash.

100-year flow rate	Minimum depth of bury
1 to 49 cfs	5 feet
50 to 99 cfs	6 feet
100 to 499 cfs	7 feet
Greater than 499 cfs	Scour depth based on scour analysis required

FIGURE 7.1-4 WASH CROSSINGS – MINIMUM DEPTH OF BURY

Wash crossings with a 100-year flow above 500 cfs will have the scour depth estimated using Arizona State Standard Attachment SSA 5-96, Guideline 2, Level I, as published by the Arizona Department of Water Resources. The engineer will estimate the depth of scour and design the top of pipe to be 3 feet below the estimated scour depth. The engineer will provide a detailed analysis of the scour depth with final plans for review and approval.

All pipelines that must be located within the scour zone or will not meet the minimum required depth of bury, as indicated above, will be protected by installing a cut-off wall downstream of the pipeline to stabilize the scour depth to a minimum of 3 feet above the pipeline. The engineer will design the cut-off wall and include details on the improvement plans. Plan Review will review pipe protection and scour stabilization requirements on a case-by-case basis.

GRAVITY SANITARY SEWER SERVICE CONNECTIONS

7-1.409

The engineer will make every effort to use existing sanitary sewer lines that have been stubbed out to a property by previous construction. Where the use of stubbed out lines are not feasible, the existing line will be abandoned and capped at the sanitary sewer main. If the existing service line is connected to a manhole, the trough of the manhole will be rebuilt to conform to the active lines.

A. Minimum Diameters for Service Lines

- Residential: 4 inch
- Multi-family: 6 inch
- Commercial: 6 inch

B. Installation

All service line connections will be installed perpendicular to the sanitary sewer line in accordance with MAG Standard Detail No. 440-3, www.ScottsdaleAZ.gov/design/COSMAGSupp and extended to the back of the public utility easement and marked. Within the rights-of-way or easement, no bends in the service line will be allowed.

C. Location

1. All proposed service line connections will be shown on the final plans with stations and dimensions or offsets, from street centerline. Typical separation dimensions from the water service lines shall be shown. Each lot or building must be provided with its own individual service line unless otherwise approved in writing by the Water Resources Department.
2. The service line location should be coordinated to avoid conflicts with other utilities, with driveway locations and should be located within the downstream 1/3 of the fronting sanitary sewer line length.
3. Because water lines are located behind the curb in many locations, conflicts with sanitary sewer service lines are possible. Sanitary sewer lines should be designed to allow for the sanitary sewer service lines to pass under water lines with 12 inches of vertical clearance to minimize potential health hazards.
4. When it is not possible to maintain sufficient vertical clearance or the sanitary sewer service line will pass over the water main, the sanitary sewer service line must be encased in concrete of 6 inches minimum thickness to 6 feet from each side of the crossing or ductile iron pipe must be used for the same distance. See MAG Standard Detail No. 404-2, www.ScottsdaleAZ.gov/design/COSMAGSupp.

D. Service Line Connection to Large Diameter Sanitary Sewer Lines

Sanitary sewer lines 15 inches in diameter or larger, may be tapped only with a manhole. Service lines into manholes may be angled, but the flow line of the service line should not be more than 4 inches below the crown of the sanitary sewer line.

E. Service Line Connections into Manholes on Small Diameter Sewer Lines

No more than 4 service lines may be made into any manhole on a sanitary sewer line 14 inches in diameter or smaller, without written approval from the city. Sanitary sewer service line inverts will be not be more than 1 service line pipe diameter above the crown of the downstream sanitary sewer line in the manhole.

F. Service Line Connections at Cleanouts

Sanitary sewer service connections will be located a minimum of 2 feet downstream of the cleanout structure.

G. Maintenance

The property owner receiving wastewater service is responsible for maintenance of the sanitary sewer service line including the wye connection to the public main.

7-1.410 PRESSURIZED SANITARY SEWER SERVICE CONNECTIONS

Pressurized sanitary sewer ejector systems will be owned, operated and maintained by the property owner. The property owner's civil engineer is responsible for the design and hydraulic analysis of the pressurized system.

A. Connection of Individual Ejector to Adjacent Gravity Sanitary Sewer Line

The sanitary sewer service line constructed within the rights-of-way will be per MAG Standard Detail No. 440-3, www.ScottsdaleAZ.gov/design/COSMAGSupp. The pressurized line will connect into the gravity service line outside of the rights-of-way and if applicable, the adjacent public utility easement. Connection to the gravity service line will be at a cleanout connection.

B. Connection of Individual Ejector(s) Downstream of a Property

The city does not support extending private pressurized ejector lines across the frontages of adjacent lots or properties. The developer or property owner will request a meeting with the Water Resources Department to discuss available options. One potential option is for the developer or owner to design and construct a segment of a public gravity collection system

within the public rights-of-way or private street tract and a lift station at the low terminus of the segment.

Water Resources approves the extension of individual private ejector lines across the frontages of adjacent properties in the following places:

1. Private manholes receiving wastewater from ejector lines (the first downstream public manhole shall be coated or lined to prevent corrosion).
2. Individual ejector lines from parcels shall be run within a private sewer easement, adjacent to any public rights-of-way and utility easement. Spare conduits shall be provided and clearly labeled on a plan detail, in the event a line becomes plugged or damaged.
3. Where individual ejector lines exceed 600 feet in length or have retention times exceeding 3 hours, the engineer will evaluate the potential for odor problems. The city will not accept odor-absorbing materials in basket containment, placed within manholes. Odor management will be incorporated through the use of biofiltration processes.

GREASE, OIL AND SAND INTERCEPTORS 7-1.411

Grease, oil and sand interceptors will be provided for laundries, restaurants, automobile service facilities, car washes and other similar facilities. The engineer will contact the Water Quality Division to determine if an interceptor is required and which type of interceptor is best suited for the proper handling of liquid wastes. Interceptors will be installed and maintained by the owner and made accessible to the city.

Each business, restaurant or establishment shall discharge to a separate interceptor.

Each interceptor shall be shown to scale, stationed on the plans.

The civil engineer shall coordinate with the mechanical engineer to assure the following are considered in the design of grease interceptors:

1. Design is compliant to the plumbing code as adopted by the city.
2. Tanks size is appropriate to the maximum projected flow from the establishment and anticipates a 30 to 90 day maintenance schedule.
3. Potential to develop odors.
4. Separation from pedestrian areas or corridors.
5. Avoid locating grease interceptor in parking garages, streets and under public parking spaces.
6. Ease of cleanup after maintenance and pumping.
7. Kitchen garbage grinders should be avoided, but if installed must be routed through the interceptor.
8. Dishwashers equipped with booster heaters and or using water in excess of 140 degrees F shall not pass through an interceptor with less than 1,000 gallon capacity.
9. Grease traps shall only be installed for ice cream shops, small coffee shops or sandwich shops (contact Water Treatment for authorization of grease traps).

For more detail contact the Water Quality Division, www.ScottsdaleAZ.gov/water/Quality.

TRACT AND EASEMENT REQUIREMENTS 7-1.412

All public sanitary sewer lines located outside the public rights-of-way or a private street tract must be placed within a minimum 20-foot easement located within a dedicated tract (portion of a utility tract, drainage tract or open space tract), unless approved otherwise by the Water Resources Department. The sanitary sewer line shall be located a minimum of 6 feet from the edge of the easement. The easement will be accessible from a public rights-of-way, will be free of obstructions, will not be located within a fenced area and will be accessible at all times to city service equipment such as trucks, backhoes, etc. Areas in question will be approved in writing by the Water Resources Department.

Sanitary sewer line easements, located outside of paved areas, will have a 10-foot-wide hardened path with a cross-sectional slope not greater than 10 percent. The hardened path will consist of native soil compacted to 95 percent to a depth of 1 foot from the existing or design surface, whichever is lower. Any revegetation within the easement will consist of low growing shrubs or plant material acceptable to the Water Operations Division. Trees may be located along the edge of the easement but not within 7 feet of the sanitary sewer line as measured to the trunk of the tree.

Locating a public sanitary sewer line on private property within a public utility easement but without dedicating a tract will require written permission from the Water Resources Department.

A copy of any written approval from the Water Resources Department shall be submitted with the final plans.

7-1.413 EASEMENT ABANDONMENT REQUIREMENTS

When a property owner or developer believes a sanitary sewer line easement or portion thereof, is no longer required by the city, an abandonment may be requested by completing and filing an application through the city's One Stop Shop.

After completing and filing the application, the property owner or developer will send a letter requesting abandonment of the easement, along with the reason, to the Water Resources Department with the following exhibits attached:

1. A detailed map highlighting the easement to be abandoned and locations of existing water and sewer lines shown in reference to the easement.
2. If existing water and/or sewer lines are to be abandoned, a detailed civil plan prepared by a professional engineer licensed in the State of Arizona must be supplied describing the method of abandonment and any necessary relocations of the water and/or sewer lines.
3. The Water Resources Department will issue a letter recommending approval or denial of the abandonment request and any stipulations that may be required in conjunction with the abandonment.
4. This letter will be attached to an Application for Release of Easement and will be submitted by the applicant to the One Stop Shop for subsequent processing by Development Services.

Failure to comply with the above process will result in a denial of the request. Where replacement rights are requested by the city, the city will not relinquish existing rights until the replacement rights have been granted.

7-1.414 PRIVATE SANITARY SEWER LINES

Private sanitary sewer lines must meet the Maricopa County Environmental Services Department and the City of Scottsdale Building Inspection Services requirements for approval. Privately owned and maintained sanitary sewer lines shall not be located in the street rights-of-way or a in a public utility easement.

Wastewater collection systems within commercial properties will be designed as private system per the Uniform Plumbing Code and Arizona Administrative Code, Title18, Chapter 9, "Water Pollution Control".

7-1.415 ALTERNATIVE SANITARY SEWER SYSTEMS

Developers or property owners may request that the Water Resources Department consider the design of alternative wastewater systems upon their engineer's determination that conventional gravity or forced sanitary sewer systems cannot provide adequate service to the development. Contact the Water Resources Department for information regarding alternative sewer designs.

If an alternative wastewater system is acceptable to the Water Resources Department, the design concept will then be coordinated with the Maricopa County Environmental Services Department for their input.

FINAL PLANS PREPARATION 7-1.500

Construction Plan Submittal Requirements for the preparation of final plans in the city are described in Section 1-1.100. This section supplements the requirements of Chapter 1.

A. Ordinance Requirements

Upon development of property for which city wastewater service is desired and available, the developer shall submit a plan for the wastewater system prepared by a professional engineer licensed in the State of Arizona (Section 49-122).

B. Design Policy

Any variance to these standards will require written permission from the Water Resources Department.

C. Design Standards

Any project specific notes that apply to construction on the city's wastewater system are required on each set of final plans that include improvements to the city's wastewater system or a wastewater system that is to be dedicated to the city.

SPECIFIC SEWER PLAN REQUIREMENTS 7-1.501

The following paragraphs highlight requirements for the preparation of wastewater final plans that are to be submitted to the city for approval.

1. All sanitary sewer lines will be shown in both plan and profile and pipe material called out.
2. Each manhole will have a unique identifier and be labeled in both plan and profile.
3. Sanitary sewer line stationing will be along the centerline of the pipe.
4. Concrete encasement will be shown in both plan and profile. The beginning and ending stations of the encasement shall be called out.
5. If a line is to be connected to an existing system, the following note should be placed on the final plans:

> Contractor shall verify the location of the existing sanitary sewer line before proceeding with trenching.

6. Both slope and elevation must be shown on all proposed sanitary sewer lines stubbed out for future extension.
7. Where sanitary sewer lines cross water lines, storm drains or drainage culverts, the clearances will be shown in profile.
8. For permitting purposes, quantities for all items of work within the public rights-of-way and public utility easements will be included on the cover sheet of the final plans.
9. Sanitary sewer service line invert elevations will be called out for all final plans. All service line connections shall be shown on the final plans with the ends of any capped service lines located by station, offset or dimension.
10. The drawings will show all utility locations, sizes, easements, rights-of-way and other structural features affecting the sanitary sewer line.
11. Lift station plans will show all invert elevations, structural elevations, existing and finished grades, control setting elevations, structural design of the wet well and dry well, valves

and piping, surge control devices, pump suction and discharge details and any other details necessary to provide construction of the design.

12. Plans and profiles of force mains will show size, invert and grade elevations, material, existing and proposed utility locations and any other necessary details.
13. Private and dry sanitary sewer lines will be noted as such on the final plans set. The responsibility for operation and maintenance of private sewer systems will be stated on the final plans.
14. Easements within tracts will be shown and labeled in plan view. Existing County recording numbers shall be shown on the final plans.
15. Final plans must comply with any design review or preliminary plat stipulations and any accepted wastewater basis of design report.

All plan documents for sanitary sewer lines and/or wastewater treatment works will be prepared by a registered civil professional engineer licensed in State of Arizona under the provisions of ARS 32:141-145.

Additional requirements for the preparation of final plans in the city are presented in Section 1-2.100.

7-1.502 REVIEWS AND APPROVALS

All final plans that include work on the city's wastewater system or on a system which is to be dedicated to the city, must be submitted to the One Stop Shop for review. Plan Review fees must be paid at the time of plan submittal.

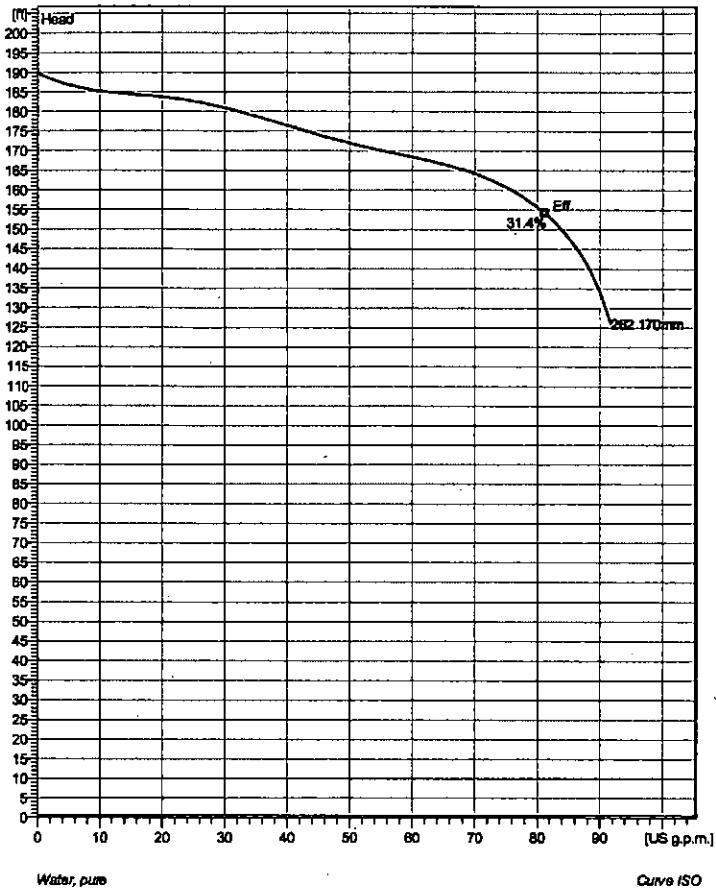
No final plans will be submitted unless accompanied by a copy of the accepted basis of design report, when one is stipulated for the project. If master plans or basis of design reports are being submitted as part of a development review board or preliminary plat package, they should also be submitted separately through the One Stop Shop for review by the Water Resources Department.

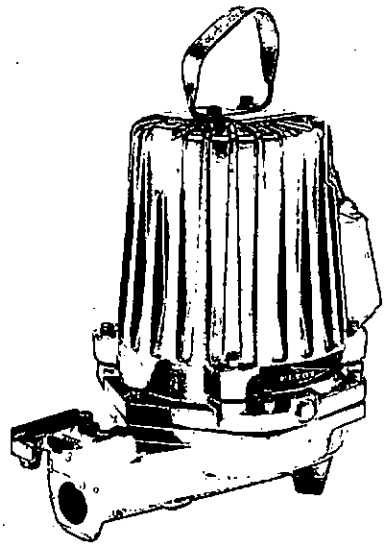
Maricopa County Environmental Services Department approval is required prior to approval of final plans by Plan Review. No permits for improvements to the public wastewater system will be issued until the owner or developer has provided all necessary easements and rights-of-way. These instruments of dedication must be approved and submitted to the city for recording at the Maricopa County Recorder's Office.

Appendix C – MP 3127 HT 3 - 262 (170mm Impeller) Pump Information

MP 3127 HT 3~ 262

Technical specification





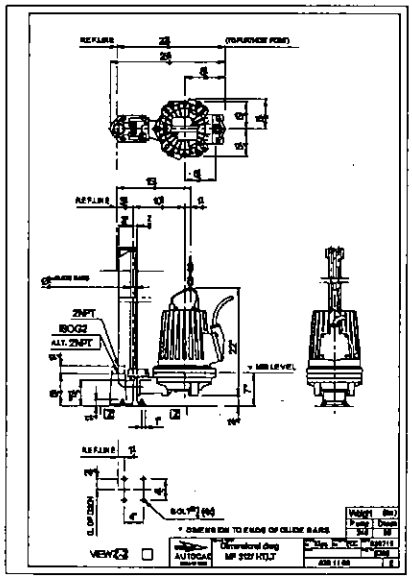
Note: Picture might not correspond to the current configuration.

General
Semi-open multi-channel impellers with integral grinder cutter in single volute casing for liquids containing solids and fibres.

Impeller

Impeller material	Grey cast iron
Discharge Flange Diameter	1 15/16 inch
Inlet diameter	1 15/16 inch
Impeller diameter	170 mm
Number of blades	6

Installation: P - Semi permanent, Wet



Motor

Motor #	M3127.170 21-11-2AL-W 11hp
Approval	Standard
Stator variant	12
Frequency	60 Hz
Rated voltage	460 V
Number of poles	2
Phases	3~
Rated power	11 hp
Rated current	13 A
Starting current	110 A
Rated speed	3495 rpm
Power factor	
1/1 Load	0.92
3/4 Load	0.90
1/2 Load	0.85
Motor efficiency	
1/1 Load	87.6 %
3/4 Load	88.4 %
1/2 Load	87.7 %

Configuration

Project	Project ID	Created by	Created on	Last update
			11.18.2016	

MP 3127 HT 3~ 262

Performance curve

Pump

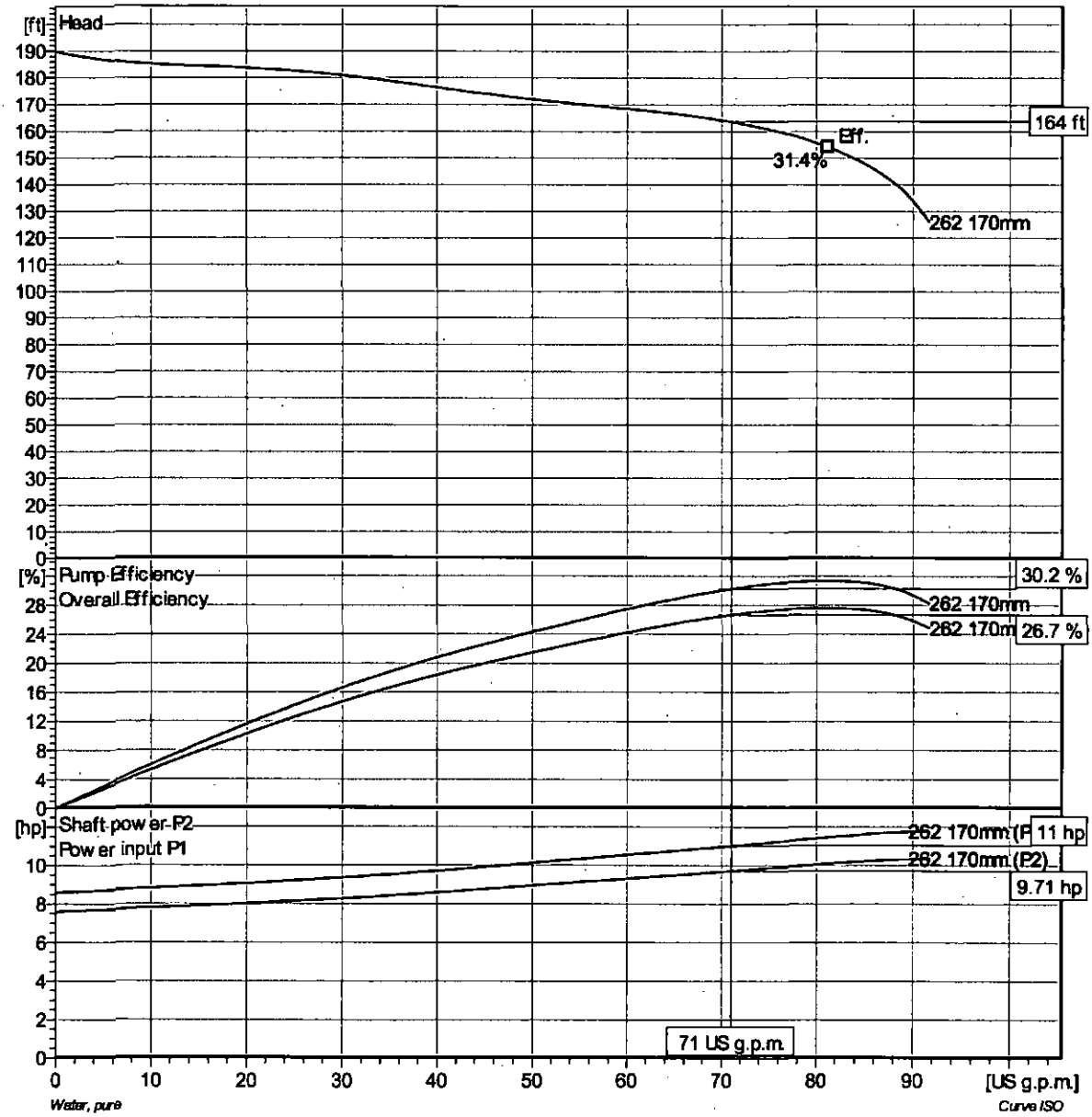
Discharge Flange Diameter	1 15/16 inch
Inlet diameter	50 mm
Impeller diameter	$6^{11}/_{16}$"
Number of blades	6

Motor

Motor #	M3127.170 21-11-2AL-W 11hp
Approval	Standard
Stator variant	12
Frequency	60 Hz
Rated voltage	460 V
Number of poles	2
Phases	3~
Rated power	11 hp
Rated current	13 A
Starting current	110 A
Rated speed	3495 rpm

Power factor	
1/1 Load	0.92
3/4 Load	0.90
1/2 Load	0.85

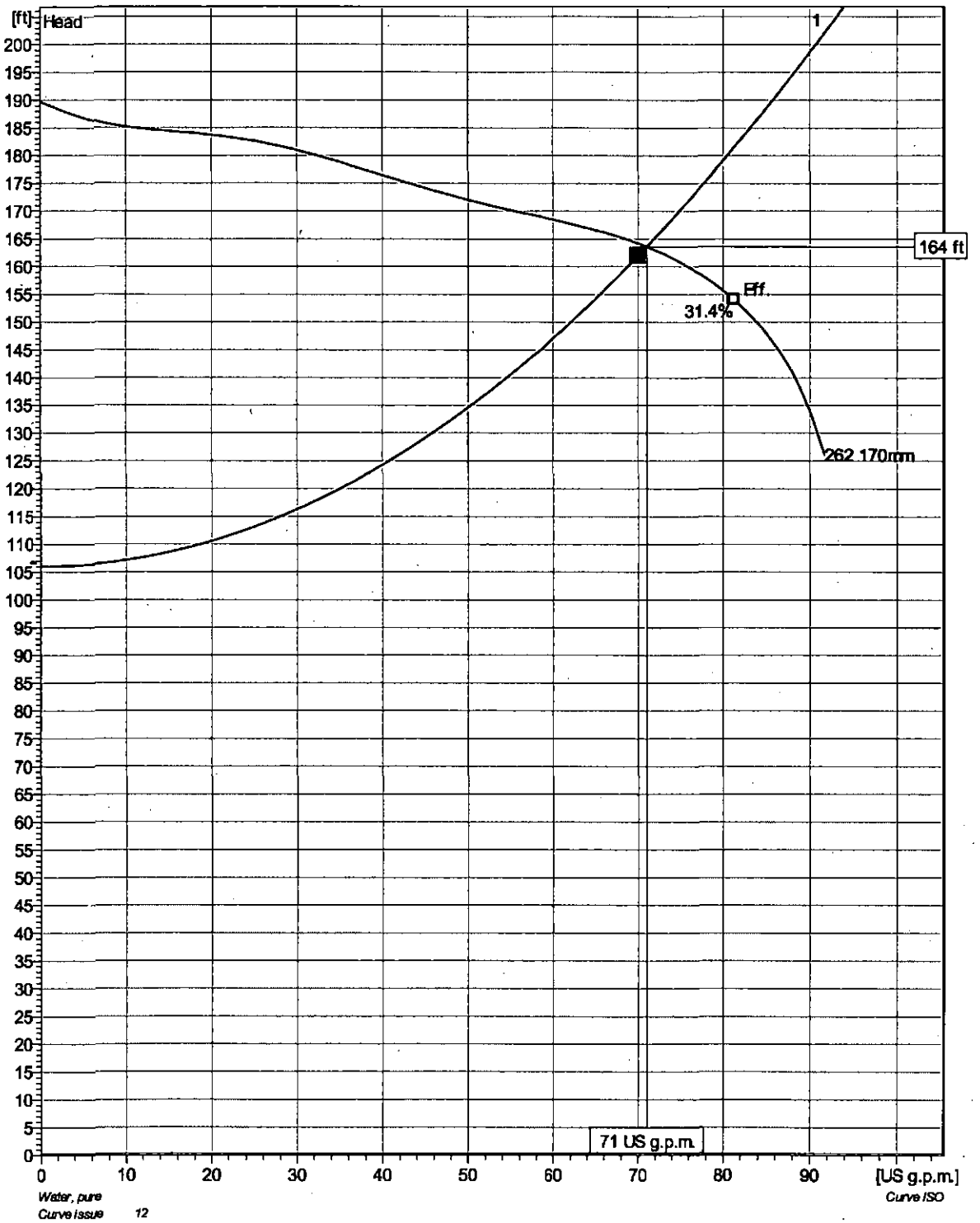
Motor efficiency	
1/1 Load	87.6 %
3/4 Load	88.4 %
1/2 Load	87.7 %



Project	Project ID	Created by	Created on	Last update

MP 3127 HT 3~ 262

Duty Analysis

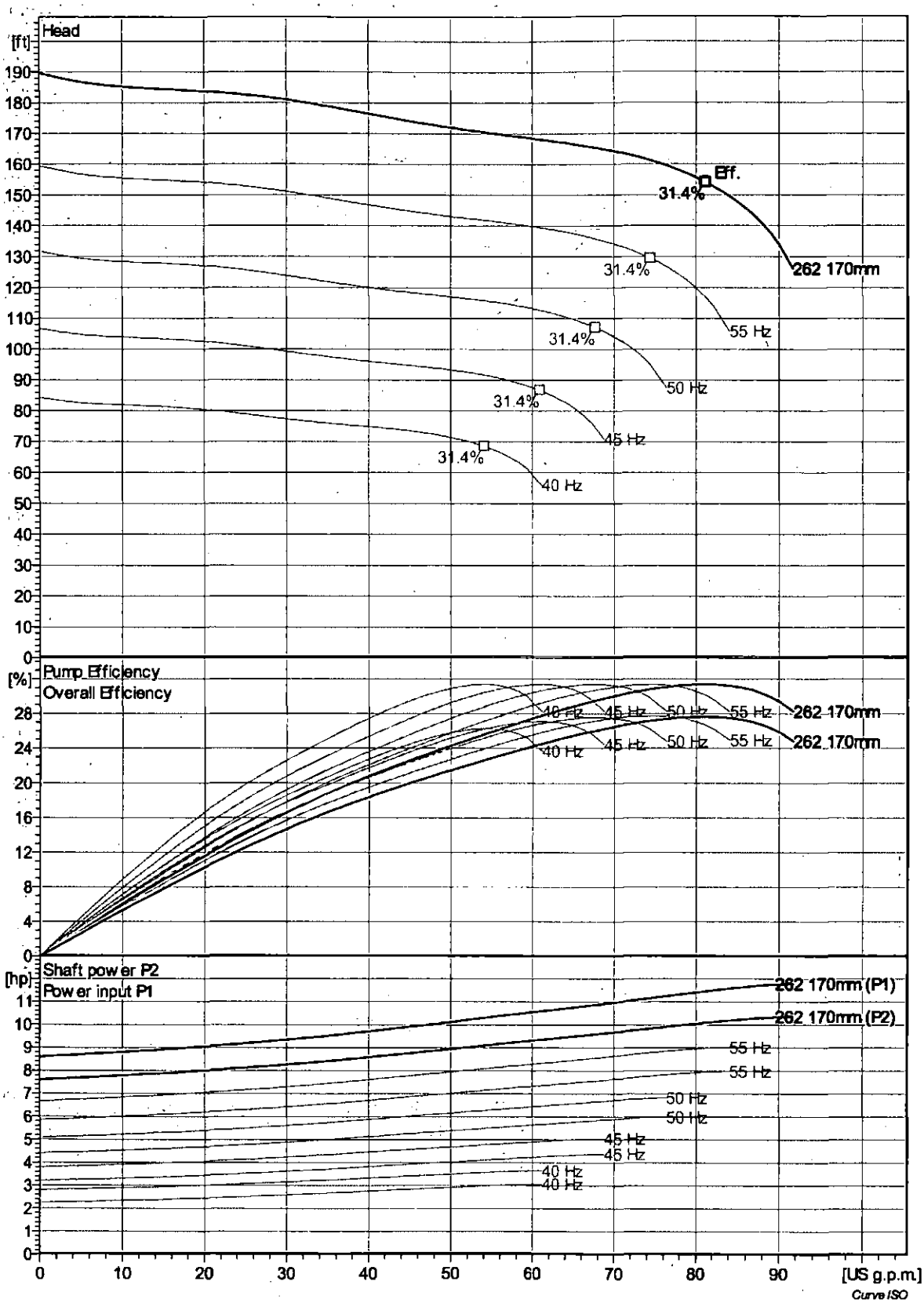


Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
1	71 US g.p.m.	164 ft	9.71 hp	71 US g.p.m.	164 ft	9.71 hp	30.2 %	1930 kWh/US MG	

Project	Project ID	Created by	Created on	Last update
			11.10.2016	

MP 3127 HT 3~ 262

VFD Curve

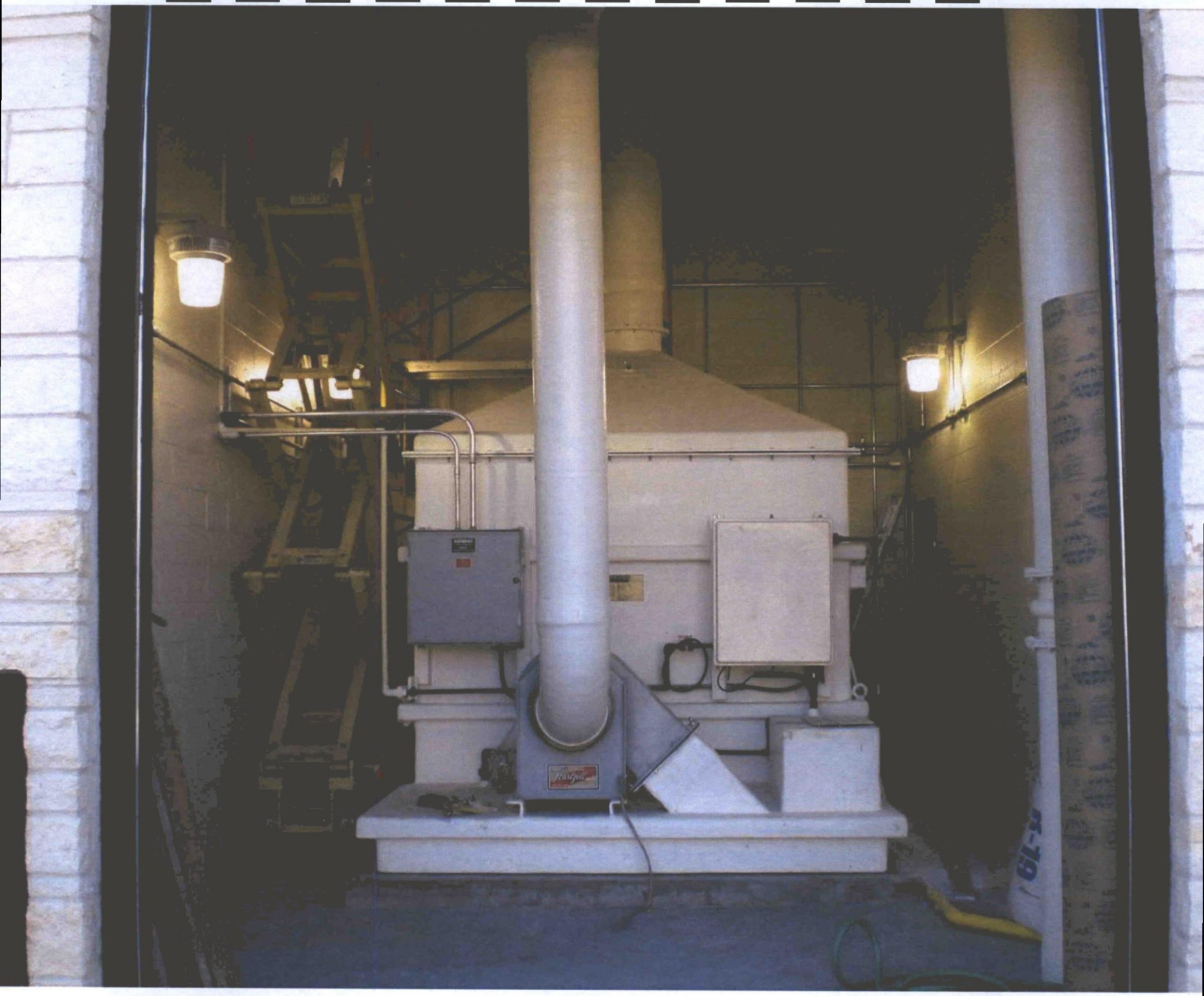


Curve ISO

Project	Project ID	Created by	Created on	Last update

Appendix D – Lift Station Layout Examples


2914

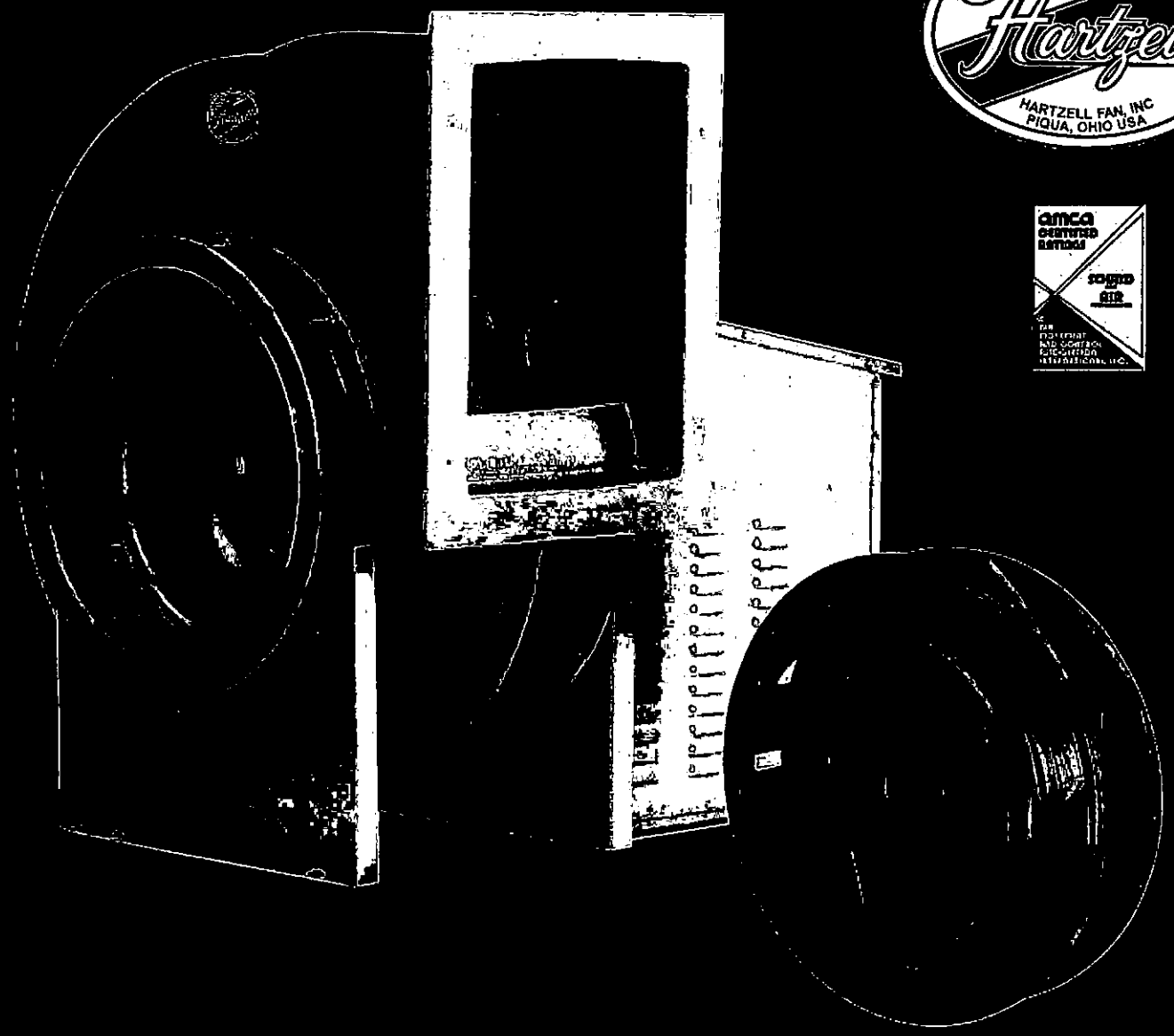



8665
NOTICE
SITE SERVICES
1-800-TOIL

Appendix E – Odor Control

Fiberglass Backward Curved Centrifugal Fans

Type FA Series 41 Series 41P



HARTZELL®

Hartzell Fan, Inc., Piqua, Ohio 45356

Index

Certified Ratings for Air and Sound

Hartzell Fan, Inc. certifies that the Series 41, Fiberglass Backward Curved Centrifugal Fans, Type FA shown on pages 7–11 and 14–21, and Series 41P, Fiberglass Backward Curved Centrifugal Fan, Packaged, shown on pages 12–20, are licensed to bear the AMCA Seal for Air and Sound Performance. The ratings shown are based on tests and procedures performed in accordance with AMCA Standard 211 and AMCA Standard 311 and comply with the requirements of the AMCA Certified Ratings Program.

Sound Performance data is available upon request. Please contact the factory and ask for Engineering Publication #SD-160.

Hartzell Model Code Explanation

Hartzell Model Code

A 41– 9 –33 1 FA 100 FG OP M 3

- Type
  - A – Production Item
  - S – Stock Item
  - Q – Special Quote
- Product Series
- Arrangement (centrifugals only)
- Size (nominal wheel diameter, inches)
- Class
- Wheel Code
- Wheel Width (entries represent percents)
- Material of Construction
- Motor Enclosure
- Motor Horsepower
- Motor RPM/Phase
  - 3 Phase: 2 = 3450, 3 = 1750, 4 = 1140, 5 = 870, 6 = 690, 7 = 575
  - 1 Phase: B = 3450, C = 1750, D = 1140, E = 870, F = 690, G = 575

Motor Horsepower

Horsepower	1/4	1/3	1/2	3/4	1	1 1/2	2	3	5	7 1/2	10	15	20	25	30	40	50	60	75	100	125	150	200
Code Letter	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Example:

Assume a needed performance of 12,000 CFM at 5" SP, standard air. Reading the 33" rating table for 100% width on page 17, we find a fan RPM of 1,168 and brake horsepower (BHP) of 12.3. Required motor horsepower is 15. The model code can be constructed as follows: Type will be a production item (code A), product series for the Fiberglass Backward Curved Fans is 41, arrangement is 9 (code 9), size of the wheel is 33", class of construction is I (code 1), wheel code for this item is FA, wheel width is 100% (code 100), material of construction is fiberglass (code FG), motor enclosure is open protected drip-proof (code OP), motor horsepower is 15 (code O), and motor RPM/phase is 1750 (code 3).

Note: All other informational fields must be filled with hyphens/dashes (-) if they are not applicable to the fan being considered.

This bulletin lists Hartzell's line of Fiberglass Backward Curved Centrifugal Fans, Type FA and accessories. More than 70 Hartzell offices can provide specific performance and installation data to meet your requirements. Call your Hartzell representative for assistance. Visit our website **(www.hartzellfan.com)** or call toll-free **(1-800-336-3267)** for the name of your Hartzell representative.

General Fiberglass Construction Features

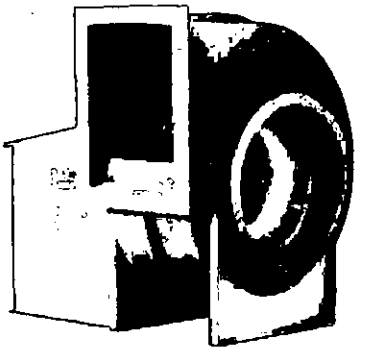
A variety of corrosion problems plague industry today. Fans and blowers made of coated steel or metals such as stainless and monel can handle some problem areas. Please refer to the corrosion resistance table on page 5 of this bulletin. Fiberglass centrifugal blowers can be used in most applications where corrosive elements exist in fume and vapor form. The resistance to corrosive elements is a major advantage, but the physical properties of fiberglass equipment offer these additional advantages:

- Fiberglass equipment is corrosion resistant.
- Fiberglass equipment weighs 25% less than comparable equipment made of carbon steel.
- Fiberglass has an extremely high strength-to-weight ratio, stronger than steel on a per-pound basis.
- Dimensional stability of fiberglass is excellent.
- Fiberglass air moving equipment will not become brittle at low temperatures and at 0°F the laminated fiberglass will be stronger than at room temperature.

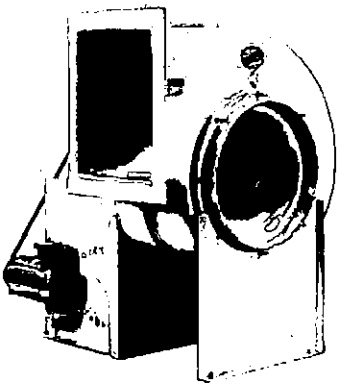
Hartzell Fan, Inc. conforms to ASTM D4167-97, Standard Specification for fiber-reinforced plastic fans and blowers, when optional surfacing veil, electrical grounding, and dynamic balancing to ASTM D4167-97 levels, are added to the fan.

The following are standard Hartzell fiberglass construction features:

- Corrosion resistant polyester resin, having a Class I flame spread rate of 25 or less is used for all housings. Vinylester resin having a Class I flame spread rate of 25 or less is used for all wheels.
- All structural parts in the airstream are fiberglass and resin. All fiberglass surfaces are protected with a minimum 10-mil thickness of chemical, flame, and ultraviolet resistant resin.
- Shafts are turned, ground, polished, and keyed at both ends with a fiberglass sleeve in the airstream. Shafts are sized to operate well below critical speed. 304 or 316 Stainless steel or monel shafting is available as an option at extra cost.
- Internal hardware (airstream) is Type 304 stainless steel. All internal hardware (airstream) is encapsulated. All external hardware (out of airstream) is zinc plated as standard. Where metal is subject to attack by the corrosive elements being handled, all metal parts can be resin-coated after assembly.
- A fiberglass and neoprene shaft seal is placed where the shaft leaves the housing along with a neoprene shaft slinger between the seal and wheel on belt drive units (seal is not gas tight).



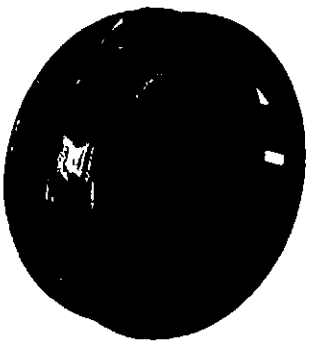
Series 41P



Series 41

Fiberglass Centrifugal Fans

- Bearings on belt drive units are heavy duty, deep row radial ball or double row spherical roller type self-aligning and shielded in cast iron housings. Long inner races ensure even load distribution, providing a high radial and thrust load capacity. Bearings are relubricable for continuous service with lubrication tubes extended to the exterior of fan base as necessary.
- V-Belt Drives are oversized for long life and continuous duty as standard. Fixed pitch or variable pitch drives are available upon request. Belts are oil, heat, and static resistant type.



Type FA Wheel

Type FA Wheel Features

The Type FA wheel is unique in the fan and blower industry. It is available in diameters from 12" to 60" in both clockwise and counter-clockwise rotations. The wheel is airfoil design and solid fiberglass die formed and coated with Dow Derakane 510-A corrosion resistant vinylester resin. The manufactured wheel is a single piece, removed from the pattern whole. This ensures each wheel is aerodynamically identical and provides reliable repeatable performance without the variability of hand made and taped components. The design is the result of a substantial investment in research, development, tooling, and manufacturing methods by Hartzell Fan, Inc.

The type FA wheel is highly efficient, with tapered inlet side and airfoil blades. It has non-overloading horsepower characteristic curve. When used in conjunction with a precision inlet cone it **efficiently moves large volumes of air at high pressures with low noise characteristics at low RPM.**

The fiberglass resin has a Class I flame spread rate of 25 or less. The wheel is electronically statically and dynamically balanced to the requirements of Fan Application Category BV-3 of AMCA ANSI Std. 204-96 and receives an Operational Test and Inspection before shipment. Special constructions are available for abrasive environments or extremely corrosive environments.

Hartzell Selection Guide

The Hartzell Fiberglass Backward Curved Centrifugal Fan performances on the following pages are based on standard air conditions (sea level, 70°F, and 29.92 inches barometric pressure). Performance data does not include drive losses on belt drive units.

How to use Performance Tables

1. Select a model for a given air delivery and pressure by looking up the required flow vertically along the left column of the performance table and moving to the required pressure. The model is identified with each table.
2. Note the required RPM and BHP. Refer to page 2 Hartzell Model Code Explanation for additional details.
3. If non-standard temperature or altitude is involved, correct to standard air density (see Temperature/Altitude Applications).

When placing your order, be sure to specify the Hartzell Model Code. Be sure to include fan model, performance requirements, operating temperature, motor data (enclosure, voltage, mounting position, etc.), and a list of required accessory items. (See pages 22 and 23.) For selection assistance and additional data contact your local Hartzell Sales Representative for assistance.

Temperature/Altitude Applications

When a fan operates in ambient conditions, generally it is handling standard air at 70°F, 29.92" barometric pressure, weighing 0.075-lbs./cu. ft. For an application where the fan operates at other than ambient conditions (temperature, altitude, or both), correction factors must be applied to the selection of the fan. In addition, the standard construction of the fan must be modified.

Correction factors for temperatures and altitudes are provided in Table 1. When a fan operates at other than ambient conditions, the correction factors in Table 1 will be required to correct static pressure and horsepower.

Table 2 shows the maximum safe operating speeds for each size fan wheel. At high temperatures, these maximum safe operating speeds should be derated.

Table 3 provides maximum safe speed correction factors by temperature and material construction. An example on the use of these tables appears at the bottom of this page.

Table 1 Altitude/Temperature Correction Factors

Temp.*(°F)	-50	-25	0	25	50	70	100	125	150	175	200	250
Factor	0.77	0.82	0.87	0.91	0.96	1.00	1.06	1.10	1.15	1.20	1.25	1.34

Alt.** (Ft.)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
Factor	1.00	1.04	1.08	1.12	1.16	1.20	1.25	1.30	1.35	1.40	1.46

Above table has inverted values. Actual density is the reciprocal of the above values.
***At sea level. **At 70°F.**
For corrections involving both temperature and altitude, correction factors should be multiplied.
Example: 150°F at 7000 ft.: Temperature factor 1.15 x altitude factor 1.30 = 1.50 combined correction factor.

Table 2 Maximum Safe Speeds @70°F

Fan Size	100% Width	66% Width
12	4,520	5,320
15	3,600	4,340
18	2,990	3,610
22	2,440	2,950
24	2,240	2,710
27	2,000	2,410
30	1,840	2,220
33	1,670	2,020
36	1,530	1,850
40	1,370	1,660
44	1,240	1,500
49	1,130	1,360
54	1,020	1,230
60	920	1,110

Table 3 Maximum Safe Speed Correction Factors*

Temp. (°F)	0	70	100	150	175	200	225	250
FRP	1.00	1.00	1.00	0.98	0.95	0.91	0.82	0.70

*** To correct maximum safe operating speeds (Table 2) for high temperatures, multiply those speeds by correction factors from Table 3.**

Use of Correction Factors and Tables

First select size, RPM and BHP of the blower needed.

If temperature or altitude is involved, correct to standard air.

Example: Assume the required performance to be 12,000 CFM at 4.62" SP, 175°F and 2000 feet altitude.

1. Temperature factor 1.20 x altitude factor 1.08 = 1.30 combined correction factor.
2. Correct SP to standard 4.62" SP x 1.30 = 6" SP for 70°F at sea level.
3. A Series 41, size 33" class II 66% width belt drive backward curved centrifugal, selected from the rating tables (page 17) for the new condition shows 12,000 CFM at 6" SP, 1,398 RPM and 15.5 BHP.
4. Correct the horsepower and static pressure in item 3 to non-standard performance by dividing by factor: 6" SP divided by 1.30 = 4.62" SP; 15.5 BHP divided by 1.30 = 11.9 BHP.
5. Check the maximum safe speed. Maximum speed at 70°F for fan size 33" 66% width, 2,020 RPM. Using the maximum safe speed factor table for fiberglass construction yields a safe speed factor of .95. The maximum safe speed is 2,020 x .95 = 1,919 RPM; thus operation at 1,438 RPM at 175°F is satisfactory.
6. Final performance of the unit at the assumed conditions: 12,000 CFM at 4.62" SP, 1,398 RPM, 11.9 BHP at 175°F and 2000 feet altitude.
7. Size motor for cold startups and use a special high altitude motor if altitude exceeds 3300 feet.

Corrosion Resistance Guide

Temperature values shown are for immersion or condensate contact applications. Where temperature values are shown, resin is suitable for hood and duct type applications for the full operating temperature range of the product. See product specifications for materials of construction and maximum operating temperature limits.

Environment	Hetron 693 Ashland F.	6694 Reichold F.	510A Dow F.
ACIDS			
Acetic to 10%	180	200	210
Acetic to 50%	90	160	180
Acetic to 100%		NR	NR
Acrylic to 25%	–	100	100
Benzene Sulfonic to 25%	180	210	150
Benzene Sulfonic 25% up	90	210	NR
Benzoic	250	220	210
Boric	180	220	210
Butyric to 50%	150	150	210
Butyric 50% up	–	100	80
Carbonic	160	220	NR
Chloroacetic to 25%	NR	*180	*150
Chloroacetic 25% to 50%	NR	*150	*120
Chromic to 5%	100	110	150
Chromic to 10% to 20%	–	NR	150
Citic	*200	*220	*210
Fluoboric	*S90	*S220	*S210
Gluosilicic up to 10%	S100	S150	S180
Formic up to 10%	200	150	180
Gluconic to 50%	120	180	180
Hydrobromic to 25%	*160	*170	*180
Hydrochloric to 15%	*230	*210	*180
Hydrocyanic to 10%	200	170	210
Hydrofluoric to 10%	***S100	***S150	***S150
Hydrofluorsilicic up to 10%	*S100	*S150	*S180
Hypochlorous to 20%	90	110	NR
Lactic	*200	*220	*210
Maleic	170	210	210
Nitric to 5%	200	170	150
Nitric 5% to 20%	–	140	120
Oleic	200	220	210
Oxalic	*220	*220	*210
Perchloric to 10%	H&D	**150	**150
Phosphoric	*220	*S210	*S210
Phosphoric, super	–	*S210	*S210
Phthalic Anhydride	*150	*210	*210
Picric to 10%	100	170	NR
Silicic	–	220	NR
Stearic	200	220	210
Sulfamic to 25%	160	150	NR
Sulfuric to 25%	*200	*220	*210
Sulfuric to 50%	*200	*200	*180
Sulfuric to 70%	*150	*180	*100
Sulfuric to 80%	NR	80	NR
Sulfurous to 10%	90	110	120
Tannic	200	220	210
Tartaric	220	220	210
Trichoroacetic to 50%	*90	*220	*200
ALCOHOLS			
Amyl	200	210	120
Benzyl	NR	100	NR
Butyl	190	150	120
Ethyl	90	120	80
Methyl	90	80	NR
GASES AND VAPORS			
Ammonia, Dry	90	170	100
Ammonia, Wet	90	NR	NR
Bromine, Wet	90	*100	NR
Carbon Dioxide	250	250	250
Carbon Monoxide	200	250	250
Chlorine, Dry	*200	*210	NR
Florine	–	NR	80
Hydrogen Fluoride, Vapor	*90	*S180	*S180
Hydrogen Sulfide to 5%	250	240	180
Sulfur Dioxide, Dry	200	250	210
Sulfur Dioxide, Wet	200	250	210
Sulfur Trioxide, Wet	–	220	210

Environment	Hetron 693 Ashland F.	6694 Reichold F.	510A Dow F.
ALKALIES (Synthetic Veil)			
Ammonium Bicarbonate to 50%	140	S170	160
Ammonium Carbonate	120	S140	150
Ammonium Hydroxide to 5%	S90	S180	S180
Ammonium Hydroxide to 10%	S90	S170	S150
Ammonium Hydroxide to 29%	NR	S100	S100
Barium Carbonate	180	S240	210
Barium Hydroxide to 10%	–	S170	150
Calcium Hydroxide to 15%	160	S210	S180
Magnesium Carbonate	160	S210	180
Potassium Bicarbonate to 10%	90	S170	S150
Potassium Carbonate to 10%	90	S180	S150
Potassium Hydroxide to 25%	NR	S120	S150
Sodium Bicarbonate to 10%	140	S210	S180
Sodium Carbonate to 35%	90	S180	S180
Sodium Hydroxide to 10%	NR	S160	S180
Sodium Hydroxide to 25%	NR	S160	S180
Sodium Sulfide	90	S220	S210
Trisodium Phosphate to 50%	–	S175	210
SALTS			
Aluminum Chloride	*120	*240	*210
Aluminum Potassium Sulfate	160	240	210
Aluminum Sulfate	250	240	210
Ammonium Chloride	*200	*220	*210
Ammonium Nitrate	200	220	220
Ammonium Persulfate	150	200	180
Ammonium Persulfate, saturate	150	NR	NR
Ammonium Sulfate	200	220	220
Aniline Sulfate to 25%	150	220	210
Aniline Sulfate, saturated	150	220	NR
Barium Chloride	200	240	210
Barium Sulfide	NR	S210	180
Calcium Chlorate	180	220	220
Calcium Chloride	250	240	220
Calcium Sulfate	*200	*240	*210
Copper Chloride	*250	*220	*220
Copper Cyanide	90	S220	210
Copper Fluoride	NR	S170	NR
Copper Sulfate	250	240	210
Ferric Chloride	*250	*220	*210
Ferric Nitrate	170	220	210
Ferric Sulfate	200	220	210
Ferrous Chloride	*220	*220	*210
Ferrous Nitrate	160	220	210
Ferrous Sulfate	220	220	210
Lead Acetate	160	220	210
Magnesium Chloride	220	240	210
Magnesium Hydroxide	–	S210	210
Magnesium Sulfate	200	210	210
Mercuric Chloride	*210	*220	*210
Mercurous Chloride	210	220	210
Nickel Chloride	220	220	210
Nickel Nitrate	220	220	210
Nickel Sulfate	220	220	210
Potassium Chloride	200	240	210
Potassium Dichromate	200	220	210
Potassium Ferricyanide	200	220	210
Potassium Nitrate	200	220	210
Potassium Permangnate	150	210	210
Potassium Persulfate	90	220	210
Potassium Sulfate	200	240	210
Silver Nitrate	200	220	210
Sodium Acetate	150	220	210
Sodium Bisulfate	200	220	210
Sodium Chloride	200	240	180
Sodium Chlorite to 10%	175	170	150
Sodium Cyanide	100	220	210
Sodium Dichromate	160	220	210

Environment	Hetron 693 Ashland F.	6694 Reichold F.	510A Dow F.
SALTS (cont'd.)			
Sodium Ferricyanide	220	220	210
Sodium Floride	–	S180	S180
Sodium Nitrate	220	220	210
Sodium Nitrite		220	NR
Sodium Silicate PH less than 1	160	210	NR
Sodium Sulfate	180	240	210
Sodium Sulfite	–	220	210
Stannic Chloride	*180	*220	*210
Stannous Chloride	*200	*220	*210
Zinc Chloride	200	*220	*210
Zinc Nitrate	180	220	210
Zinc Sulfite	150	220	NR
SOLVENTS			
Acetone to 10%	NR	180	180
Benzene	90	80	NR
Carbon Disulfide	NR	NR	NR
Carbon Tetrachloride	90 VAPOR	110	150
Chlorobenzene	NR	NR	NR
Ethyl Acetate	NR	NR	NR
Ethyl Chloride	90 VAPOR	NR	NR
Ethylene Dibromide	NR	NR	NR
Ethylene Glycol	250	220	210
n-Heptane	120	210	210
Hexane	–	150	160
Methyl Ethyl Ketone to 10%	NR	80	NR
Naphtha	200	210	180
Naphthalene	130	220	210
Tetrachloroethylene	NR	100	80
Toluene	90	NR	80
Xylene	90	80	80
BLEACHES			
Calcium Chlorate	180	220	220
Calcium Hypochlorite	100	NR	S160
Chlorine Dioxide up to 15%	–	160	*200
Chlorine Water	*125	*210	*200
Hydrogen Peroxide to 30%	120	100	150
Sodium Chlorate	90	210	210
Sodium Hypochlorite to 15%	NR	125	S180
OTHERS			
Alum. Chlorohydroxide to 50%	–	220	210
Ammonium Phosphate	150	210	210
Aqua Rega	NR	*80	NR
Detergents	120	170	150
Glycerine	200	220	210
Kerosene	120	210	180
Photographic Solutions	–	80	NR
Perchlorethylene	NR	100	80
Sodium Tetraborate	180	S210	180
Sodium Tripolyphosphate	125	210	210
Sodium Xylene Sulfonate	–	170	160
Sorbitol Solutions	180	220	160
Urea	90	170	150
Urea-Ammonium-Nitrate	–	120	120
Fertilizer Fumes	100	120	150
Shell-D-D	NR	100	NR
Steam Vapor	180	210	180

Reference
C.R.G.1.1

NOTES: **NR = Not Recommended S = Synthetic surfacing veil or mat required. Contact factory. "–" = No test data available**

*** Special shaft and hardware required, contact factory.**

**** Special design considerations required (explosive environment), contact factory.**

***** Do not use HartKoate. Special shaft and hardware required, contact factory.**

For environments not shown, or when temperatures exceed the maximum listed, contact factory.

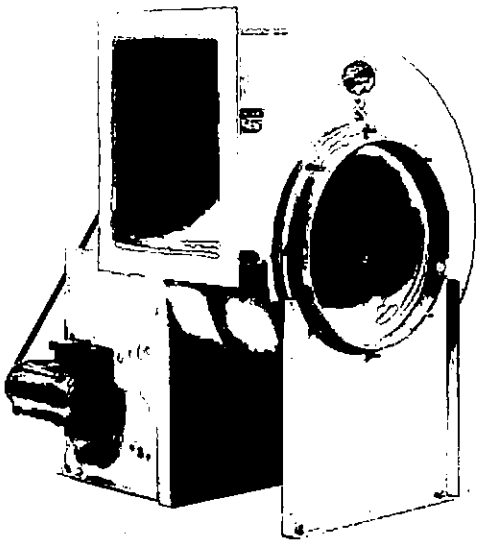
Hydrocarbon fuel environments may require static grounding, contact factory.

Do not use HartKoate (Alum. Oxide) with Hydrofluoric acid.

Series 41 Backward Curved Centrifugal Fan, Type FA

Series 41 Hartzell Fiberglass Backward Curved Centrifugal Fans offers **non-overloading, high efficiency, low noise,** and economy for corrosive atmospheres. This fan is unique in the fan and blower industry. The fan incorporates the proven, highly efficient, backward curved, airfoil-bladed, solid fiberglass, Type FA wheel in a solid fiberglass housing. This design incorporates the airfoil centrifugal wheel, centrifugal fan housing, and inlet cone to produce a compact, highly efficient unit with low noise characteristics.

- **Applications** – Developed for compatible corrosive applications where it is advantageous to have fiberglass materials and have the motor out of the airstream with the versatility of a belt drive fan.
- **Performance** – Type FA fiberglass airfoil wheel with inlet cone and aerodynamically designed housing produces from **800 CFM to 90,000 CFM at pressures from free delivery to 14" W.G.** at high efficiencies with non-overloading horsepower, low noise, and low RPM. Maximum temperature capability is 250°F.

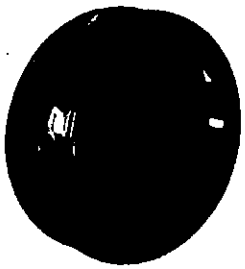


Series 41

amca CERTIFIED RATINGS SOUND AIR

Hartzell Fan, Inc. certifies that the Series 41, Fiberglass Backward Curved Centrifugal Fans, Type FA, shown herein are licensed to bear the AMCA seal for air and sound performance. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

Sound Performance data is available upon request. Please contact the factory and ask for Engineering Publication #SD-160.



Type FA Wheel

Features

- **Sizes** – 12", 15", 18", 22", 24", 27", 30", 33", 36", 40", 44", 49", 54", and 60" wheel diameters. Available in Class I and II in 100% width and Class I, II, and III in 66% width. Available in Belt Drive Arrangements #1, #9, and #10, Direct Drive Arr. #4 and Direct Coupled Arr. #8. Contact Factory for Arr. #8 dimensions and for other arrangements.
- **FRP Materials** – Solid fiberglass wheel molded with Dow Derakane 510-A corrosion resistant vinylester resin having a Class I flame spread rate of 25 or less. The housing and other standard FRP components are constructed of fiberglass and Ashland Hertron 693 corrosive resistant polyester resin having a Class I flame spread rate of 25 or less. No metal parts are exposed in the airstream. See Corrosion Resistance Guide on page 5 for resin characteristics. Other resins are available.
- **Type FA Wheel** – **High efficiency, airfoil** design with **one-piece, solid fiberglass,** construction. Tapered inlet side design efficiently moves large volumes of air at high pressures. Wheel has non-overloading horsepower characteristic curve.
- **Rotation and Discharge Positions** – Available in both clockwise and counterclockwise rotations and in all standard discharge positions. Housing discharge position can be changed on fan sizes 12" through 36". Larger size housings are non-rotatable.
- **Easy Installation and Maintenance** – Motor, drives, and bearings are readily accessible for ease in wiring, installation, adjustment, and lubrication.
- **Shafts** – Shafts are turned ground and polished, keyed at both ends with fiberglass sleeve in the airstream and sized to operate well below critical speed.
- **Bearings** – Bearings are heavy duty, self-aligning, ball or roller type, in cast iron pillow block housings, selected for minimum L-50 Life of 250,000 hours, and include extended lubrication fittings as standard.
- **Standard Shaft Seal** – A fiberglass and neoprene shaft seal is placed where the shaft leaves the housing along with a neoprene shaft slinger between the seal and wheel. Seal is not gas tight.
- **Hardware** – Airstream hardware is Type 304 stainless steel and encapsulated.
- **Motor Out of the Airstream** – Exterior mounting of Drip-Proof Protected motor on an adjustable motor slide base in belt drive models is standard. Motors can be furnished as TEFC, Mill and Chemical Duty, or to specifications upon request. Motor HP and frame size limits are identified in Dimensions and Material Specifications table.
- **Drives (Belt Drive Fans)** – V-Belt Drives are oversized for long life and continuous duty and are fixed pitch as standard option. Variable pitch drives are available upon request. Belts are oil, heat, and static resistant type.
- **Balancing** – The fan is electronically statically and dynamically balanced to the requirements of Fan Application Category BV-3 of AMCA ANSI Std. 204-96. All fans receive an inspection prior to shipment and, whenever possible, an operational test.
- **Flanged Duct Connections** – Outlet flange is standard, inlet flange is optional. Flange bolt holes are optional.
- **Bases** – Heavy gauge, welded, hot rolled steel with epoxy coating are standard.
- **Options and Accessories** – See pages 22 and 23.
- **Spark Resistant Construction and Protective Coatings** – Spark resistant construction for fiberglass equipment is optional, and for abrasive environments or extremely corrosive environments, special construction is available, see page 23.

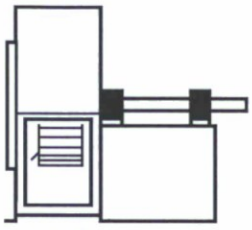
Hartzell Centrifugal Fan Classifications

Hartzell Series 41 Fiberglass Backward Curved Centrifugal Fans, Type FA, 100% width, are designed and classified to perform within the centrifugal fan classification parameters established by AMCA Standard No. 2408; AMCA Publication 99. Hartzell Series 41 Fiberglass Backward Curved Centrifugal Fans, Type FA, 100% width are available in Class I and II construction. Hartzell Series 41 in 66% width are available in Class I, II, and III construction. Series 41P are available in Class I construction only. See performance tables for specific ratings. These parameters are explained in the following table.

FAN CLASS	PERFORMANCE RANGE*	TABLE SHADING
I	5" @ 2300 FPM To 2½" @ 3200 FPM	
II	8½" @ 3000 FPM To 4¼" @ 4175 FPM	
III	13½" @ 3780 FPM To 6¾" @ 5260 FPM	

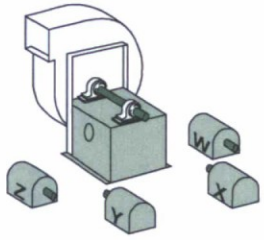
*** At standard air conditions (70°F, 29.92 in. HG barometric pressure, .075 lbs./ft.3). Static pressure shown in inches of water; outlet velocity shown in feet per minute. Performance Ranges apply only to 100% width construction.**

Centrifugal Fan Arrangements



Arrangement 1

Unit furnished with shaft and bearings, less motor and drive. Designed to be driven by a separately mounted motor. Impeller is overhung – two bearings on base. Temperature limitations: 250°F.

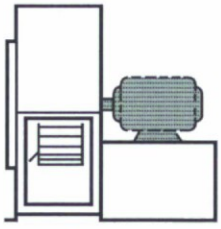


Motor Position Designation

Motor position designation is necessary when ordering the following for Arrangement 1 fans –

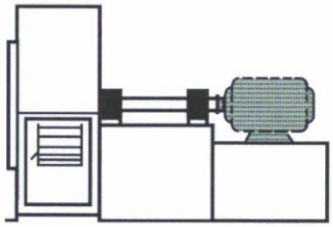
1 – V Belt Drive.
2 – Vibration Bases.
3 – Belt Guards.

Note: Location of motor is determined by facing the drive side of the fan and designating the motor position by letters W, X, Y, or Z. Consider discharge location and height when specifying.



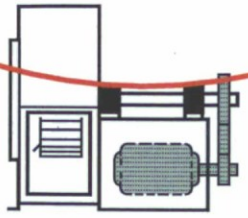
Arrangement 4

Direct drive packaged unit, wheel is overhung and attached to the shaft of the electric motor. No bearings on fan. Temperature limitations: 200°F.



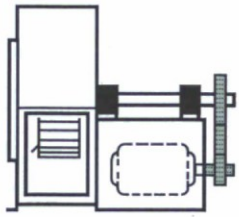
Arrangement 8

Direct coupled configuration with motor mounted to common fan base. Impeller is overhung and supported by two bearings on fan base. Temperature Limitations: 250°F.



Arrangement 9

Belt drive configuration with motor mounted on outside of bearing base support. Packaged unit, wheel is overhung, slide rail motor base permits easy adjustment of belt tension. Available on either left or right hand side of base (when facing drive end of shaft). Temperature limitations: 250°F.



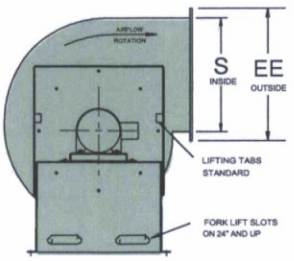
Arrangement 10

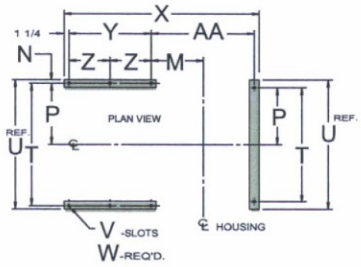
Belt drive configuration with motor mounted inside base. Packaged unit, wheel is overhung. Temperature limitations: 250°F.

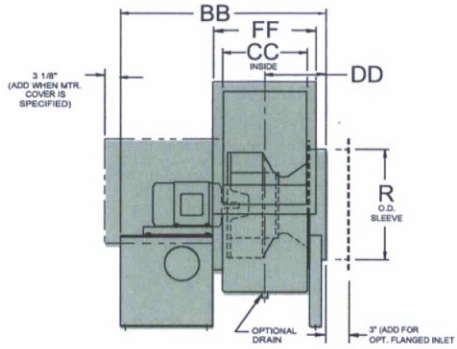
Adapted from AMCA Standard 99-2404-03, *Drive Arrangements for Centrifugal Fans*, and AMCA Standard 99-2407-03, *Motor Positions for Belt or Chain Drive Centrifugal Fans*, with written permission from Air Movement and Control Association International, Inc.

Dimensions – Arrangement 4

SERIES 41, Type FA
Sizes 12" Through 33", Rotatable Housing
Standard Construction – Classes I, II and III, Maximum Temperature – 200°F.







Principal Dimensions (Inches) – Sizes 12" – 33"

Fan Size	A	B		C	D	E	F	G	H	J	M		N
		Class I/II	Class III								100% Width	66% Width	
12	16	15 1/2	15 1/2	13	11 1/2	12 1/4	20 1/8	10 3/4	10	11 1/16	8 7/16	7 7/8	5/8
15	18 3/4	18 5/8	19 5/8	16 3/16	15 7/8	16 11/16	25 1/2	14 15/16	14	13 1/16	9 11/16	9	5/8
18	22	21 15/16	22 7/8	19	18 7/16	19 9/16	28 1/2	17 5/16	16 3/16	15 1/16	10 15/16	10 1/8	5/8
22	26 3/4	26 1/4	27 3/16	21 1/8	22 11/16	24 1/16	34 3/8	21 5/16	19 15/16	18 9/16	12 7/8	11 9/16	5/8
24	28 1/2	28 5/16	29 1/4	23	24 7/16	25 15/16	37 3/16	22 15/16	21 7/16	19 15/16	13 3/8	12 1/4	7/8
27	32 1/4	32 1/2	32 1/2	24	27 7/16	29 1/8	40 3/16	25 13/16	24 1/8	22 7/16	14 5/8	13 3/8	7/8
30	34 3/4	35	35	28 1/2	29 9/16	31 3/8	43 7/16	27 3/4	25 13/16	24 1/16	15 11/16	14 5/16	7/8
33	38	38 3/16	38 3/16	28 11/16	33 1/4	35 1/4	47 9/16	31 1/4	29 1/4	27 3/16	16 13/16	15 5/16	7/8

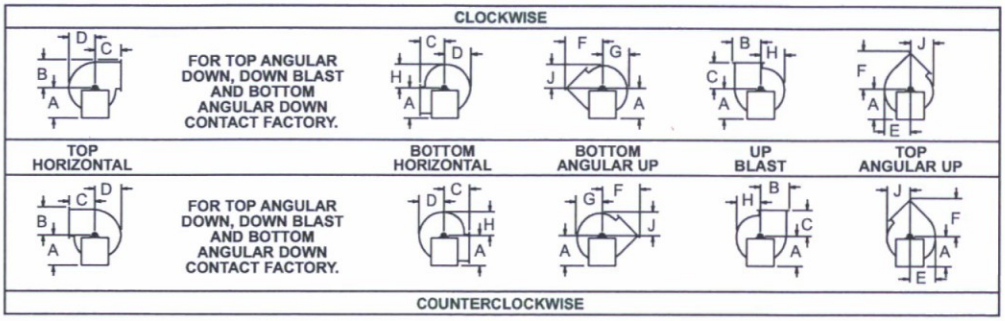
Fan Size	P	R	S	T	U	V	W	X		Y	Z	AA	
								100% Width	66% Width			100% Width	66% Width
12	9 1/8	12 1/4	12 7/8	18 1/4	19 1/2	9/16 x 1 1/16	6	26 7/16	25 9/32	9 1/2	–	14 11/16	13 17/32
15	10 3/4	16 1/2	16 1/8	21 1/2	22 3/4	9/16 x 1 1/16	6	36	34 5/8	16 1/2	–	17 1/4	15 13/16
18	12 3/8	19 1/2	19 3/8	24 3/4	27 3/4	9/16 x 1 1/16	6	40 5/16	39 1/4	19	–	19 11/16	18
22	14 1/2	23 7/8	23 5/8	29	30 1/4	9/16 x 1 1/16	6	44 1/4	42 3/16	19	–	23	21
24	15 7/8	25 7/8	25 3/4	31 3/4	33 1/2	11/16 x 1 3/16	6	45 13/16	43 5/8	19	–	24 9/16	22 3/8
27	17 5/8	28 3/4	29	35 1/4	37	11/16 x 1 3/16	6	48 1/2	46	19	–	27 1/4	24 3/4
30	18 7/8	31 3/16	31 1/2	37 3/4	39 1/2	11/16 x 1 3/16	8	52 5/16	50 1/4	21 1/2	10 3/4	29 3/16	26 1/2
33	20 5/8	34 3/16	34 11/16	41 1/4	43	11/16 x 1 3/16	8	57 1/2	54 9/16	23 3/4	11 7/8	31 1/2	28 9/16

Fan Size	BB		CC		DD		EE				FF			
	100% Width	66% Width	100% Width	66% Width	100% Width	66% Width	100% Width		66% Width		100% Width		66% Width	
							Class I/II	Class III	Class I/II	Class III	Class I/II	Class III	Class I/II	Class III
12	27 3/16	26 1/32	9 9/32	8 5/8	8	7 7/16	18 1/8	18 1/8	18 1/8	18 1/8	14 3/8	14 3/8	13 1/2	13 1/2
15	36 11/16	35 1/4	11 11/16	10 5/16	9 1/4	8 1/2	21 1/16	23 1/8	21 1/16	23 1/8	16 5/8	18 11/16	15 1/4	17 5/16
18	41 5/8	39 3/4	14	12 5/16	10 7/16	9 3/8	24 1/2	26 3/8	24 1/2	26 3/8	19 1/16	21	17 3/8	19 5/16
22	45 1/8	42 13/16	17 1/8	15 1/16	12	11	28 3/4	30 5/8	28 3/4	30 5/8	22 1/4	24 1/8	20 3/16	22 1/16
24	46 7/16	44 3/16	18 5/8	16 3/8	12 13/16	11 11/16	30 13/16	32 3/4	30 13/16	32 3/4	23 11/16	25 5/8	21 7/16	23 3/8
27	49	46 1/2	21	18 1/2	14 1/8	12 7/8	36	36	36	36	28	28	25 1/2	25 1/2
30	53 1/2	50 3/4	22 13/16	20 1/16	15 1/16	13 11/16	38 1/2	38 1/2	38 1/2	38 1/2	29 13/16	29 13/16	27 1/16	27 1/16
33	58 1/16	52 13/16	25 1/8	22 1/8	16 1/4	14 3/4	41 11/16	41 11/16	41 11/16	41 11/16	32 1/8	32 1/8	29 1/8	29 1/8

Dimensions and specifications are subject to change. Clockwise rotation is shown. Certified prints are available.

Fan Discharges

TAD, BAD, and DB discharge must have discharge extension. Contact factory.



Material Specifications/Weights

Series 41

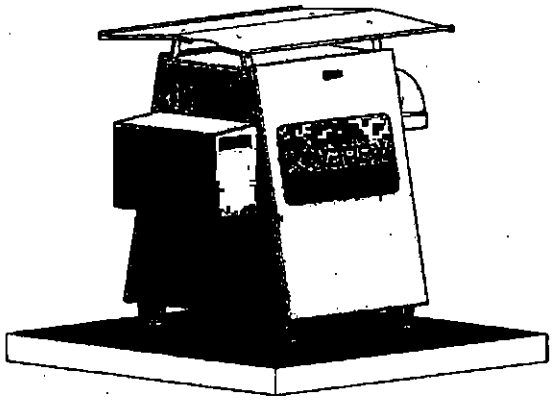
Class	Fan Size	Flanges				Shaft & Bearings		FA Type Wheel WR² (Lbs.-Ft.²)	Motor Frames			Installation Weights (Lbs. Less Motor)	
		Inlet		Outlet					Minimum Arr. #4	Maximum Arr. #4	Maximum Arr. #9 & #10	Arr. #4	Arr. #9 & #10
		Thickness	Holes	Thickness	Holes 100% & 66%	Size	Type						
I	12	1/8	7/16 x 8	1/4	7/16 x 10	1 3/16	P3U219	1.6	56	184T	182T	160	193
	15	3/16	7/16 x 8	1/4	7/16 x 14	1 3/16	P3U219	4.7	143T	215T	184T	235	230
	18	3/16	7/16 x 8	1/4	7/16 x 14	1 7/16	P3U223	11	143T	256T	213T	350	355
	22	1/4	7/16 x 8	1/4	7/16 x 18	1 7/16	P3U223	29	182T	286T	215T	490	490
	24	1/4	7/16 x 8	1/4	7/16 x 18	1 7/16	P3U223	44	182T	286T	254T	580	605
	27	5/16	7/16 x 8	3/8	7/16 x 18	2 3/16	P3U235	78	182T	286T	254T	660	770
	30	5/16	7/16 x 8	3/8	7/16 x 18	2 7/16	P3U239	119	213T	326T	256T	935	975
	33	5/16	7/16 x 8	3/8	7/16 x 22	2 7/16	P3U239	160	254T	365T	284T	1145	1185
	36	5/16	7/16 x 8	3/8	7/16 x 22	2 11/16	P3U243	251	—	—	286T	—	1550
	40	5/16	7/16 x 8	1/2	7/16 x 26	2 15/16	P3U247	423	—	—	324T	—	2015
	44	3/8	7/16 x 8	1/2	7/16 x 30	2 15/16	P3U247	717	—	—	324T	—	2515
	49	3/8	9/16 x 16	1/2	7/16 x 34	2 15/16	P3U247	1180	—	—	326T	—	2940
	54	7/16	9/16 x 16	1/2	7/16 x 34	2 15/16	PB22447	1810	—	—	364T	—	3340
	60	7/16	9/16 x 16	1/2	7/16 x 38	2 15/16	PB22447	2875	—	—	365T	—	3670
II	12	1/8	7/16 x 8	1/4	7/16 x 10	1 7/16	P3U223	1.6	56	184T	184T	160	202
	15	3/16	7/16 x 8	1/4	7/16 x 14	1 7/16	P3U223	4.7	143T	215T	215T	235	235
	18	3/16	7/16 x 8	1/4	7/16 x 14	1 11/16	P3U227	11	143T	256T	256T	350	355
	22	1/4	7/16 x 8	1/4	7/16 x 18	1 11/16	PB22427	29	182T	286T	256T*	490	505
	24	1/4	7/16 x 8	1/4	7/16 x 18	1 11/16	PB22427	44	182T	286T	286T*	580	625
	27	5/16	9/16 x 8	3/8	7/16 x 18	2 3/16	PB22435	78	182T	286T	286T*	660	800
	30	5/16	9/16 x 8	3/8	7/16 x 18	2 7/16	PB22439	119	213T	326T	286T*	935	995
	33	5/16	9/16 x 8	3/8	7/16 x 22	2 7/16	PB22439	160	254T	365T	326T*	1145	1195
	36	5/16	9/16 x 8	3/8	7/16 x 22	2 11/16	PB22443	251	—	—	326T*	—	1620
	40	5/16	9/16 x 8	1/2	7/16 x 26	2 15/16	PB22447	423	—	—	365T*	—	2060
	44	3/8	9/16 x 8	1/2	7/16 x 30	2 15/16	PB22447	717	—	—	365T*	—	2560
	49	3/8	11/16 x 16	1/2	7/16 x 34	2 15/16	PB22447	1180	—	—	405T*	—	3040
	54	7/16	11/16 x 16	1/2	7/16 x 34	2 15/16	PB22447	1810	—	—	405T*	—	3480
	60	7/16	11/16 x 16	1/2	7/16 x 38	2 15/16	PB22447	2875	—	—	405T*	—	3670
III	12	1/8	9/16 x 8	1/4	7/16 x 10	1 11/16	P3U227	1.6	56	184T	184T	160	213
	15	3/16	9/16 x 8	1/4	7/16 x 14	1 11/16	P3U227	4.7	143T	215T	215T*	235	250
	18	3/16	9/16 x 8	1/4	7/16 x 14	1 15/16	P3U231	11	143T	256T	256T*	350	375
	22	1/4	9/16 x 8	1/4	7/16 x 18	1 15/16	PB22431	29	182T	286T	256T*	490	525
	24	1/4	9/16 x 8	1/4	7/16 x 18	1 15/16	PB22431	44	182T	286T	286T*	580	635
	27	5/16	9/16 x 16	3/8	7/16 x 18	2 3/16	PB22435	78	182T	286T	286T*	660	820
	30	5/16	9/16 x 16	3/8	7/16 x 18	2 7/16	PB22439	119	213T	326T	286T*	935	1040
	33	5/16	9/16 x 16	3/8	7/16 x 22	2 7/16	PB22439	160	254T	365T	326T*	1145	1210
	36	5/16	9/16 x 16	3/8	7/16 x 22	2 11/16	PB22443	251	—	—	326T*	—	1630
	40	5/16	9/16 x 16	1/2	7/16 x 26	2 15/16	PB22447	423	—	—	365T*	—	2080
	44	3/8	9/16 x 16	1/2	7/16 x 30	2 15/16	PB22447	717	—	—	365T*	—	2580
	49	3/8	11/16 x 16	1/2	7/16 x 34	2 15/16	PB22447	1180	—	—	405T*	—	3110
	54	7/16	11/16 x 16	1/2	7/16 x 34	2 15/16	PB22447	1810	—	—	405T*	—	3500
	60	7/16	11/16 x 16	1/2	7/16 x 38	2 15/16	PB22447	2875	—	—	405T*	—	3800

*Motor Frames exceeding these values must be Arrangement 9M, Arrangement 1, or Arrangement 8.
For other Arrangement maximum motor frame size and dimensions, please contact factory.

Series 41P

Class	Fan Size	Flanges				Shaft & Bearings			FA Type Wheel WR² (Lbs.-Ft.²)	Maximum Motor Frame Arr. #10	Installation Weights (Lbs. Less Motor)
		Inlet		Outlet							
		Thickness	Holes	Thickness	Holes 100% & 66%	Size	Drive Side	Inlet Side			
II	12	1/8	7/16 x 8	1/4	7/16 x 10	1 11/16	P3U-227	P3U-227	1.6	215T	188
	15	3/16	7/16 x 8	1/4	7/16 x 14	1 11/16	P3U-227	P3U-227	4.7	215T	215
	18	3/16	7/16 x 8	1/4	7/16 x 14	1 15/16	P3U-231	P3U-231	11	254T	309
	22	1/4	7/16 x 8	1/4	7/16 x 18	1 11/16	P3U-227	P3U-227	29	256T	397
	24	1/4	7/16 x 8	1/4	7/16 x 18	1 15/16	P3U-231	P3U-231	44	256T	554
	27	5/16	9/16 x 8	3/8	7/16 x 18	2 3/16	P3U-235	P3U-235	78	286T	728
	30	5/16	9/16 x 8	3/8	7/16 x 18	2 3/16	PB-22435	P3U-235	119	324T	878
	33	5/16	9/16 x 8	3/8	7/16 x 22	2 3/16	P3U-235	P3U-235	160	324T	1013
	36	5/16	9/16 x 8	3/8	7/16 x 22	2 3/16	P3U-235	P3U-235	251	326T	1131

ENVIRONMENTAL TECHNOLOGIES



Main Features

- Eliminates H_2S and other odorous compounds
- Reduce or eliminate some forms of Fats, Oils, and Grease (FOG)
- Reduce or eliminate biofilm or bacterial growth in the treatment area
- Reduce the rate of corrosion typically associated with low pH
- Impart a residual oxidant to the defined space to absorb unexpected spikes of odors

Specifications

System

Oxidant Output: ≤ 1.5 lbs/day
Number of Nozzles: 1-3
Standard 500 Nozzle
20 CFM
5 to 10 GPH
Low Volume Nozzle
1 CFM
1 to 2 GPH
Treatment Area
Up to 18,000 ft^3
Low Volume Nozzle – up to 1,000 ft^3

Power supply

220 VAC, 30A, 60 Hz, Single Phase or
110 VAC, 30A, 60 Hz

Physical

Aluminum Powder Coated with TGIC polyester
Dimensions
41.6"L × 29.5" W × 39.4" H
Unit Weight
150 to 165 lbs avg

Operating environment

20°F to 100°F

Description

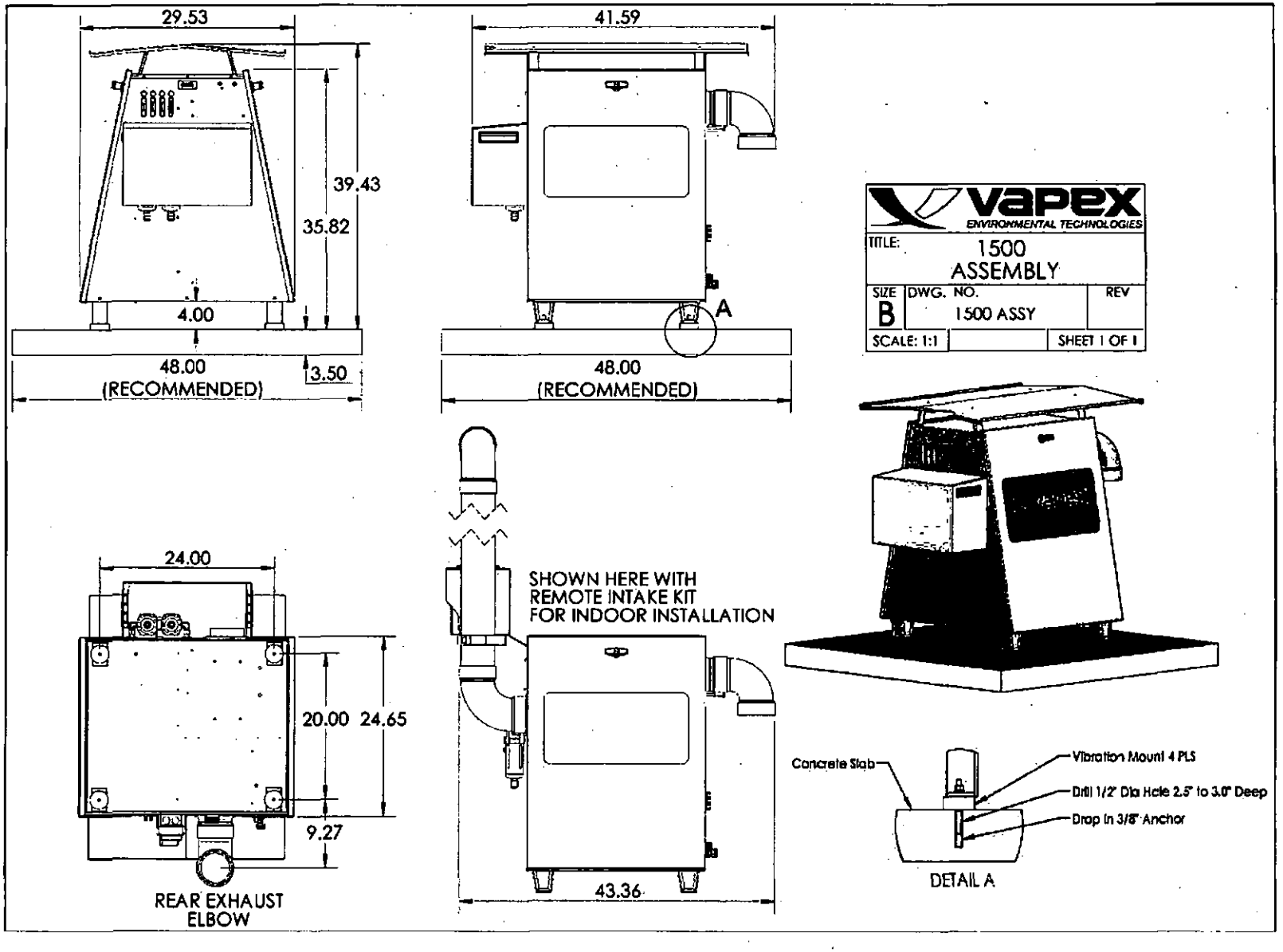
The Vapex 1500 is an odor control system specifically designed to treat H_2S, mercaptans, amines, and other odorous compounds in enclosed spaces. It combines ozone, water, and air using a patented 3-fluid nozzle to atomize the water molecules to create hydroxyl radicals. The odorous air is not extracted instead the odors are treated at the same space where they are generated.

Applications

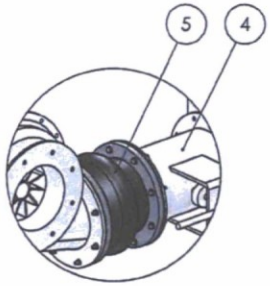
- Lift Stations/Pump Stations
- Wet Wells
- Holding Tanks
- Headworks
- Covered Clarifiers

Contact Information

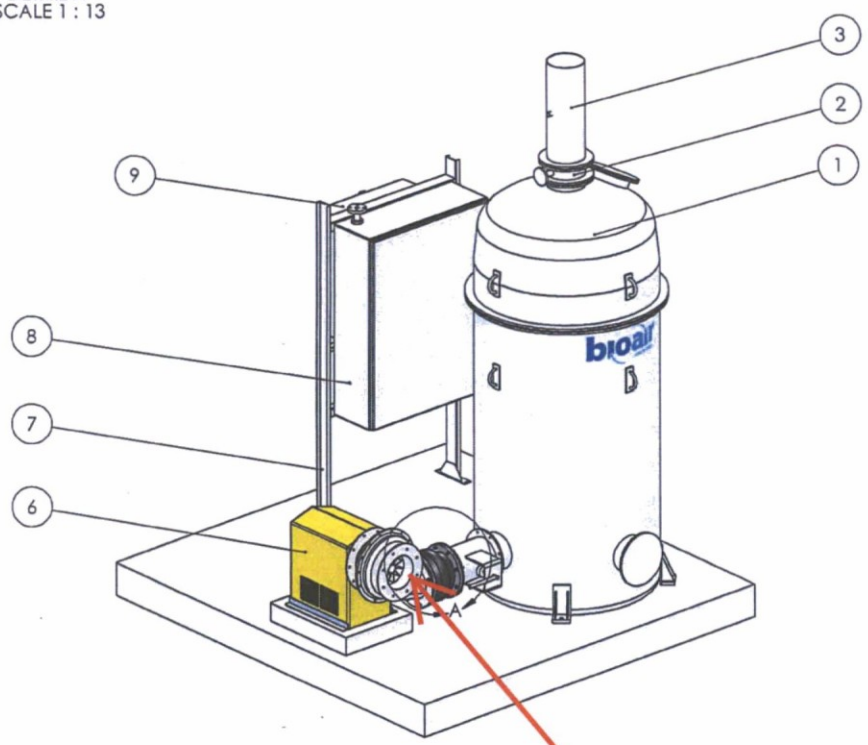
- Contact your local Vapex rep
- Call Vapex – 407-977-7250
- Email Vapex – Info@vapex.com


29.53
39.43
35.82
4.00
48.00
(RECOMMENDED)
3.50
41.59
A
48.00
(RECOMMENDED)
VAPEX
ENVIRONMENTAL TECHNOLOGIES
TITLE:
1500
ASSEMBLY
SIZE
B
DWG. NO.
1500 ASSY
REV
SCALE: 1:1
SHEET 1 OF 1
24.00
20.00
24.65
9.27
REAR EXHAUST
ELBOW
SHOWN HERE WITH
REMOTE INTAKE KIT
FOR INDOOR INSTALLATION
43.36
Concrete Slab
Vibration Mount 4 PLS
Drill 1/2" Dia Hole 2.5" to 3.0" Deep
Drop In 3/8" Anchor
DETAIL A

REV.	DATE	ECN#	REVISION RECORD	DR	CK
A	10/24/2011			KZ	



DETAIL A
SCALE 1 : 13



ITEM	PART NUMBER	QTY	DESCRIPTION	OPERATING WEIGHT (LBS)
1	RE031000	1	EF31 REACTOR ASSEMBLY WITH Ø2" ANSI 150 DRAIN	1725
2	NA081000	1		
3	ST082400	1	FRP STACK Ø8 PS1569 x 24"	
4	DV081000	1	FRP CONTROL DAMPER VALVE Ø8" PS15-69	10
5	FC080000	1	FLEX CONNECTOR SINGLE ARCH Ø8" PS15-69	10
6	BL200000	1	CAST ALUMINUM BLOWER	150
7	PS000100	1	STAINLESS STEEL PANEL STAND	49
8	WP101000	1	FRP WATER PANEL	65
9	CP000100	1	FRP ELECTRICAL PANEL	60

MATERIAL
SEE TABLE

FINISH

DRAWN BY	DATE	ENG APPR.	DATE	QC APPR.	DATE
KZ	10/24/2011				

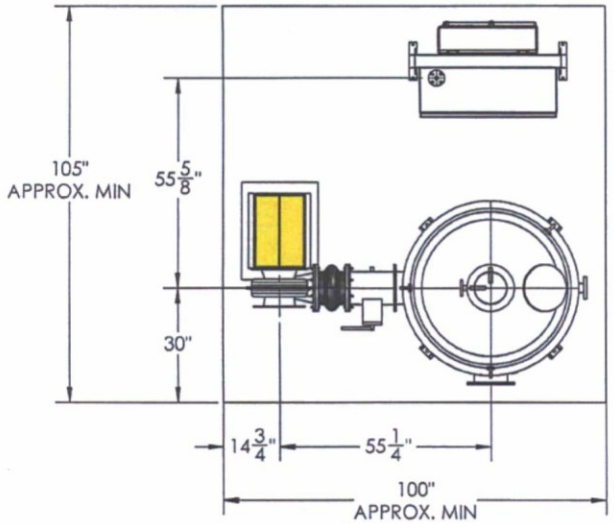
PART NAME
GENERAL ARRANGEMENT ECOFILTER™ 31

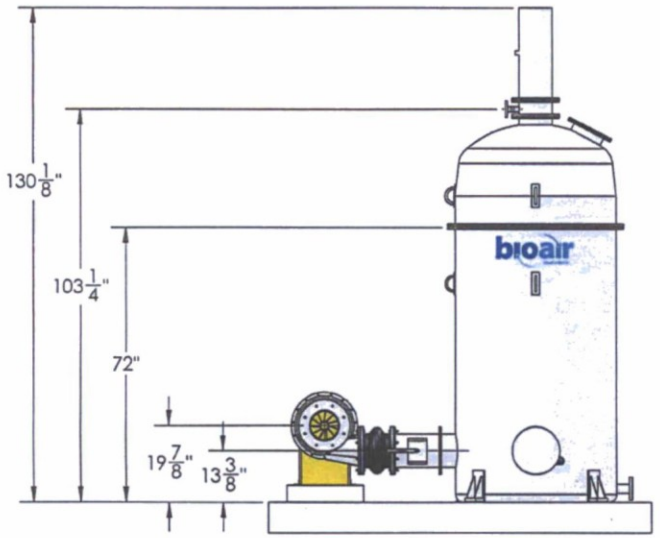
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
ANGULAR: ±1°
FRACTIONS: ±1/4
TWO PLACE DECIMAL: ±.060
THREE PLACE DECIMAL: ±.030

SIZE	DWG. NO.	REV
B	EF31_GA	A

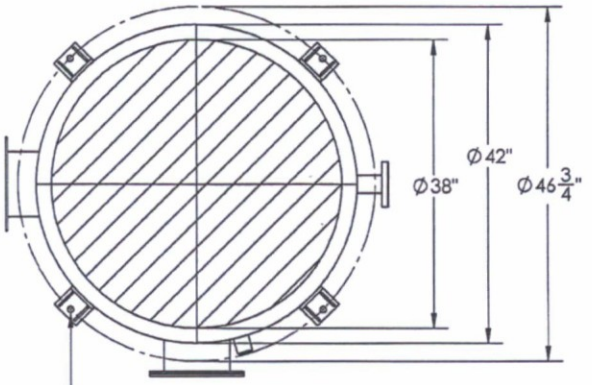
SCALE: 1 : 26 | SHEET 1 OF 2

this is the connection port, right ?



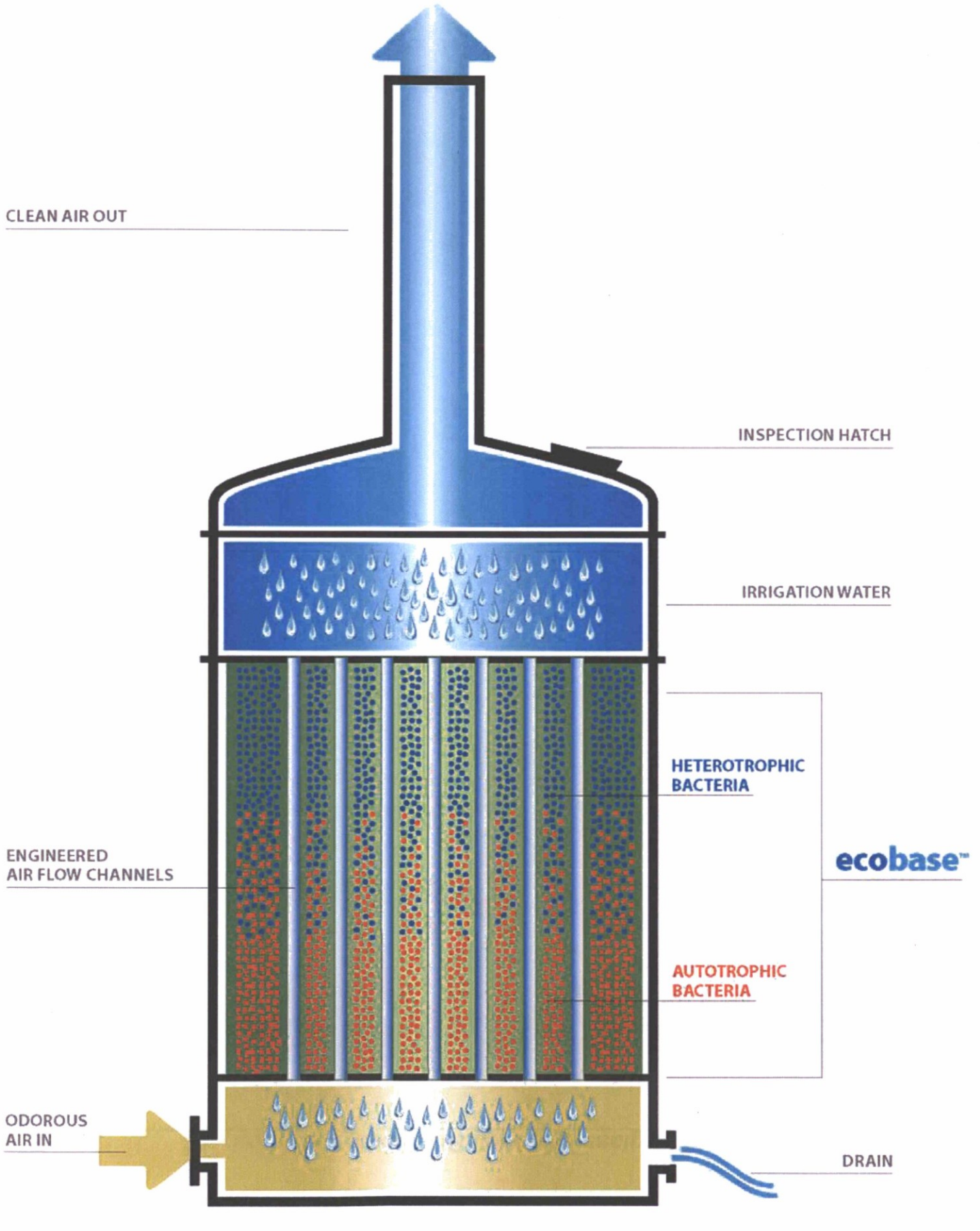


NOTES:
1. FOUNDATION PAD MUST BE FABRICATED UNIFORM IN TEXTURE AND APPEARANCE AND MEET A SURFACE PLANE TOLERANCE OF 1/8" IN 10'.
2. REACTOR TO BE SET ON 30LB FELT PAPER
3. LOAD DISTRIBUTION AREA = 1134 in^2
4. SHIPPING WEIGHT = 872 LBS, OPERATING WEIGHT = 1725 LBS



LOADING DIAGRAM
SCALE: 1 : 15

SIZE	DWG. NO.	REV
B	EF31_GA	A
SCALE: 1 : 30	SHEET 2 OF 2	


CLEAN AIR OUT
INSPECTION HATCH
IRRIGATION WATER
HETEROTROPHIC BACTERIA
ENGINEERED AIR FLOW CHANNELS
ecobase™
AUTOTROPHIC BACTERIA
ODOROUS AIR IN
DRAIN

TOP Pre-engineered Fiberglass Pump Station

THE OPTIMUM PUMP STATION

FLYGT

a xylem brand

TOP Station Premium Pre-engineered Pump Station

The Flygt TOP fiberglass pump station from Xylem is a premium, pre-engineered and factory built packaged pump station that utilizes advanced features to provide customers with superior pump station performance.

The innovative, self-cleaning, TOP Station sump bottom directs the solids and debris normally found in wastewater to the inlet of the Flygt N-Pumps where they can be effectively pumped away.

The interior of the pump station has a smooth finish which helps inhibit the build-up of grease and sludge.

The outside diameter of the station is equipped with an integral anti-flotation ring utilized to secure the station.

The aluminum pump station lid utilizes an integral Safe-Hatch access cover that provides personnel fall-through protection when the aluminum access door is opened. The raised frame provides a kick plate surround eliminating the possibility of tools or debris rolling into the pump station.

During normal inspection, individual pumps can be raised and placed upon one of the closed Safe-Hatch grates and washed-down. The debris will fall back down into the sump resulting in a clean pump to check.

Flygt Pump Station Controls

Xylem offers offers a fully engineered control panel solution. Our integrated, purposely designed control panels provide an intuitive user interface with the reliability you have come to expect from the leader in submersible pumping.

Standard Control Features

- UL 508 listed
- NEMA 4X 304 Stainless Steel enclosure with aluminum dead front inner door
- Lockable enclosure
- Hand/Off/Auto Selector switches
- Full voltage across-the-line starting
- Main incoming power circuit breaker
- Individual pump circuit breakers
- NEMA rated motor starters w/overloads
- Mini-CAS II pump seal & motor thermal protection
- MultiSmart™ intelligent pump station controller
- Current transformers
- 24VDC power supply
- ENM-10 float regulators

Available Options

- Generator receptacle and plug assembly with manual transfer switch
- Solid state reduced voltage starting
- LS-100 submersible pressure transducer
- MIO module and multi-sensor level probe
- Horn or bell audible alarm
- Anti-condensation heater and thermostat
- Back up floats (2 x ENM-10, when transducer or probe option is selected)
- Elapsed time meters for pumps
- TD-33 Telephone modem
- 12" x 10" space in panel reserved for future telemetry

Features & Benefits

- Pre-engineered, factory built pump station
  - Available in 4-ft, 5-ft or 6-ft diameters
- Heavy-wall filament-wound fiberglass tank
- Exclusive self-cleaning TOP sump bottom
- Flygt heavy-duty submersible N-Pumps
  - Clog-free, innovative technology
  - 3-hp through 35-hp motors
  - Self-cleaning N-Impeller
  - Sustains high hydraulic efficiency
- Flygt mix-flush valve
  - Provides sump mixing
  - Re-suspends solids
- 2", 3", 4" or 6" diameter discharge pipe
  - PVC discharge pipe
  - Stainless steel discharge pipe
- Stainless steel guide bars
- Stainless steel upper guide bar bracket
- Stainless steel cable holder hooks
- Integral Safe-Hatch aluminum access cover
- Flygt Grip-eye easy lift pump retrieval system
- 4-in diameter PVC station vent pipe
- Pump station level control choices
  - Flygt ENM-10 ball float-type
  - Flygt LS-100 pressure transducer-type
  - Flygt probe-type
- Duplex Flygt pump station controls
  - NEMA-4 enclosure
  - Several enclosure material choices
  - UL listed control available
  - NEMA or IEC rated starters available
  - Standard and custom controls
- Single lift, easy station installation
- Single-source responsibility

Fully sealed station wall penetrations can be factory installed for the influent pipe, discharge pipes, and electrical connection points. Depending on pipe diameter, properly selected fiberglass hubs with link seals are utilized. Influent pipe wall penetration can be shop installed or field located.

Flygt TOP Pre-engineered Pump Station

FB012 • Flygt TOP Pre-engineered Fiberglas Pump Station Brochure • 3/2016 • NACT

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