W I C K S

A Technical Guide To The Pipe Organ

WICKS PIPE ORGAN COMPANY

W I C K S

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WICKS PIPE ORGAN COMPANY

Background Information

The Wicks Organ Company

The Wicks Organ Company of Highland, Illinois was incorporated in 1908, although our organbuilding history goes back earlier than that. The company has always been a custom builder, striving to create organs that are visually and tonally beautiful. Each instrument is designed specifically for the room in which it will be heard. Every organ is built by hand by over 60 trained craftsmen in 13 different trades. A pipe organ's success depends not only on its quality of construction, durability, and beauty of tone, but on being installed in an environment favorable to acoustic instruments and voices. To create an aesthetically pleasing environment suitable to organ music, congregational and choral singing, and the spoken word requires the coordination of architects, engineers, planning committees, and the organ builder. This guide is designed to steer all involved towards the design of rooms and pipe organs that succeed in enhancing the worship service. As Wicks is a custom builder, every pipe organ is unique and has unique requirements.

The technical information contained in this guide is adequate for most instruments. When preparing for the installation of a pipe organ, it's important to check beforehand that all space, electrical, and construction requirements have been met. Your organ technician or the Wicks Organ Company will be able to help you through this process.

The history of the organ

An organ set up for testing at the Wicks Erecting Room. All parts are arranged as they will be in the final installation.

An organ, by definition, is a wind-blown musical instrument which produces its tones from pipes made of either metal or wood. Pipes are blown in response to commands from a keyboard. The organ has proven to be the instrument best suited for accompanying congregational and choral singing. Composers of church music have recognized this, providing a vast library of organ music, and a long and successful history of using organs and organ music in churches has developed. This tradition shows no signs of abating, and organs are still essential in most churches.

An important fact about pipe organs is that each of its pipes can produce only one note of a particular pitch or timbre. When that particular note is required, then that pipe must be blown. There must be a separate pipe for each key of each stop. The term stop implies a knob or tab on the console that when pulled or activated allows the organist to play that particular timbre on the keyboard. The pipes of a stop are together arranged so as to produce a graduation of pitch corresponding to the keys, but alike in loudness and tone quality. Such a set of pipes, graduated in pitch (and therefore in length) but alike in tone quality, is called a rank. Some stops may actually consist of more than one rank. Americans generally refer to the size of an organ by number of ranks, whereas the European designation of organ size is found in the number of stops. The largest pipe of a rank can be more than 32 feet or as short as 6 inches in length. Organs vary greatly depending on the role they were designed to fill, and the space available for them. Small practice instruments can be built with a single rank, while large instruments can easily contain 100 ranks or more.

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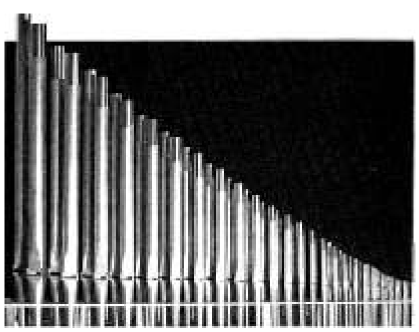
A rank of pipes, showing graduation in length and similarity of construction. Each pipe produces only one note. The encased instrument shown above consists of 3 ranks.



Large rooms and acoustics

Acoustics play a very important part in the sound which people in the congregation hear. Organs sound best in resonant rooms, where the room's reverberation allows the sound of the different stops to blend into a complex, coherent whole, as the instruments in an orchestra do. The placement of the organ also affects the degree to which its tones can be heard. Results improve if there are no obstructions between the organ and the congregation. If acoustics and placement are poor, larger scales must be considered. If acoustics and placement are both ideal, an organ of smaller scale or fewer ranks may be satisfactory. The various ranks must be scaled to match the church and the congregation's expectations, but they must also be scaled to balance within the organ so that, when multiple stops are combined, each color remains audible. Since the size of an organ affects its cost, it is wise to consider the financial burden which may be imposed by compromises in acoustics and organ placement, as well as possible aesthetic and structural consequences.

Temperature is an often overlooked aspect of room design with respect to pipe organs. While seasonal shifts in temperature and weekly changes in heating and cooling cycles will not harm the organ, they do affect the tuning. The pitch of organ pipes can drift with minor changes in temperature. Warmer air makes a pipe speak sharper, while cooler air pushes the pipe flat. For the most part, pipes will drift in pitch together, within tolerances that can be adjusted by regular seasonal tuning; however, if different departments of an organ move to different temperatures, the organ will no longer sound in tune with itself. If the pipes of an organ are to be spread over a wide area, steps must be taken to ensure that all parts of the organ are kept at a similar, if not constant, temperature.

Placement of the Organ for Best Sound

The most important consideration is that the organ, being a musical instrument, is intended to be heard. To accomplish this, nothing should obstruct the sound coming from the pipes. Accordingly, the best possible location is one in which the pipes are entirely within the room and the organ is visible from as many parts of the room as possible. The next best would be a location partly within organ chambers, which need a width at least twice their depth and large tone openings extending to within six inches of the chamber ceiling. In any event, a space of adequate size needs to be allocated, and all obstructions between tonal source and listeners must be avoided.

In buildings of traditional form, a number of possibilities present themselves. Some, but not all, might be the following:

Gallery

This is the most common location in larger buildings and is historically the traditional place for the main organ. The gallery provides an easily accessible and practical place for a free standing instrument. Generally there are no obstructions to the sound and, if the gallery is over a narthex, there will be very little seating that is not in direct line of sight with the pipework. A Gallery installation affords height, which helps the sound of the organ to progress down the nave above all obstructions. Galleries or balconies extending over seating will always cause an acoustical "dead zone" in that area.

A rear gallery installation is the best location for an organ.

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Chancel

This area offers many possibilities. Adequate spaces can often be provided in the back or at the sides of the chancel. This can allow a pleasing arrangement of the pipework and offer no obstruction to the sound.

A chancel location permits the organ to speak directly into the nave while providing additional interest for the front of the church

This completely encased, free-standing instrument is located in the nave. Its elevated height allows it to be clearly seen and heard from every seat in the church.

Nave

In some situations, the best option for organ location is within the nave itself, usually elevated enough to provide good line of sight to all parts of the room. Attention must again be directed to the appearance, as well as to the necessary supporting structure.

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In some churches where floor space is at a premium, the organ can be cantilevered from a wall or a balcony rail.

Non-Traditional Churches

In buildings of non-traditional form, there will be many other possible alternatives; in each case, however, the organ should be within the room as far as practical and all tone openings should be visible from as many places as possible. A trained organ technician or acoustician can assist in choosing the best placement of the organ in a non-traditional building.

Console Placement

Technological achievements in organ-building in just the last century have allowed much greater flexibility in console placement. The console placement of a mechanical action organ is the most limited because extended tracker runs add expense to the organ and make it more difficult to play. With Electric slider-and-pallet and DIRECT-ELECTRIC® action, the console may be located almost anywhere. It is beneficial to put some distance between the organist and the organ. In larger spaces it is possible to place the console too far away, causing a lag due to sound travel time thus making the organ more difficult to play than most would desire. Locating the console within 25 feet of the pipework is an ideal placement. In every case, a place for the console must be provided that permits the organist to view the proceedings, as well as to hear what is being played clearly and without obstruction. It is possible to build easily movable consoles with a long umbilical cable to the organ, or to make the cable detachable with multiple plug-in locations. Such flexibility allows the console to be moved to different locations for different purposes.

If church tradition dictates, there should be adequate space for the choir and for other musicians, so located that they can be conveniently directed from the console. The amount of space required varies, depending on the importance attached by the individual church to these activities. **Since choir and musicians are, like the organ, intended to be heard,** they should also be located so that there are no obstructions to the sound with a direct line of sight to all parts of the auditorium.

The non-traditional building often demands a simple design for the organ. Here angles throughout the design of the building are reflected in the contour of the facade pipes.

Background Information

In buildings of smaller proportions a completely encased, free-standing organ is usually the simplest solution and also the best.

Good console placement with unobstructed view and located close to the organ.

If an architectural element such as a window, a cross, or a baptistry is in the center of the chancel area, the organ can often be divided into sections whose visual design accentuates the central element.

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Environmental Considerations

One of the most important features of a worship service is the corporate nature of the event, meaning that people gather to do something **together**. To be successful, such corporate activity demands that people be able to hear each other, not just a speaker or a performer. Sound absorption to suppress "audience noise" is inappropriate and a certain amount of resonance or reverberation is essential. It is necessary for speaking to be understood clearly, for singing and music to be vital and authentic, and for the congregation members to be able to hear each other when they speak and sing together. Shorter reverberation times reduce the upper limit of success, both for the organ and for the rest of the corporate activities in the church. What is best acoustically for the organ also benefits congregational singing and choral presentation.

Absorbent materials are frequently used to prevent echoes from flat surfaces, which can be very annoying and make speech un-intelligible. **A better way to avoid echo is to eliminate parallel surfaces and large, flat areas.** Walls and ceilings can be made irregular, sawtooth-shaped, or non-parallel; this will break up echoes without reducing reverberation. Curved surfaces will reflect sound, but also serve to focus reverberations into a point. This will create locations in the building where sounds are easily heard, and nearby locations where sound doesn't reach at all. Small unapparent alterations or irregularities, such as intentionally building seemingly parallel walls slightly out of parallel, are frequently enough to benefit the acoustic environment. Traditional, hard-surfaced materials are always the best and, frequently, also the least expensive over the course of time.

Like the spoken word and the congregational responses, the quality of the organ also depends on the acoustics. If there is adequate reverberation, the tones blend together harmoniously and the sounds achieve grandeur. If the reverberation is inadequate, the tones become lifeless, hard and unpleasant. The most magnificent instruments, as well as the most rewarding worship experiences, are to be found in rooms with adequate reverberation. Musical magnificence is often not a requirement for church services, yet an acoustical atmosphere that permits music to be performed in its intended manner and does not subdue congregational activity to a passive whisper is often necessary. In existing acoustic environments, improvements for the sake of a new or existing organ will also benefit choral and congregational singing. For organ music, it is highly desirable to have the reverberant field dominate as close to the organ as possible, otherwise, people near the instrument may find it too loud, while those at the opposite end of the church may find it anemic. This can be done by removing all absorptive materials from the area closest to the organ as well as farther within the room.

In every situation Wicks recommends employing the services of a professional acoustician with a background in organ building to evaluate the room and to recommend any changes or improvements that may be made to enhance the worship service.

Technical Data And Specifications

Space Requirements

Pipework

Adequate space must be provided for the pipes and chests, in an unobstructed location as outlined in the Background Information on pages 4 and 5. Smaller organs are served better by locating all of the pipe work within a single area; larger organs can be divided if necessary. The width of alcoves and chambers must be no less than two times nor more than three times the depth. Air circulation in and around the pipework areas, whether they are in chambers or in free-standing cases, is important in keeping all the pipes in tune. It can be helpful to include organ chambers in a church's heating and air conditioning plan, provided that air is not being blown directly onto the pipes and that the chambers do not trap the heated or cooled air.

Facade pipes give the organ's speech immediate access into the room.

APPROXIMATE SPACE REQUIREMENTS

RANKS	MINIMUM SPACE REQUIRED	MINIMUM HEIGHT REQUIRED
2 - 3	36 sq. ft.	10'6"
4 - 5	56 sq. ft.	10'6"
6 - 8	85 sq. ft.	10'6"
10 - 12	125 sq. ft.	13'5"
13 - 15	175 sq. ft.	19'6"
20	225 sq. ft.	19'6"
25	270 sq. ft.	19'6"
30	330 sq. ft.	19'6"
35	420 sq. Ft.	19'6"
40	520 sq. Ft.	19'6"
45	620 sq. ft.	25'0"
50	730 sq. ft.	25'0"
65	920 sq. ft.	37'0"
80	1125 sq. ft.	37'0"
100	1350 sq. ft.	37'0"

- If more or less height is available, area required may increase or decrease. If areas are not rectangular, space requirements may increases substantially. Consult Wicks Organ Company about these spaces.

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Technical Data And Specifications

Console

Space for the console must be provided as outlined in the Background Information on page 8. Its size depends on the size of the organ and the style of console selected. The table shows approximate sizes of consoles. In each case passage space must be added to permit the organist to get to the console and to permit maintenance work. If the console is recessed below the surrounding floor, there must be enough room to get to the bench gracefully. The console should be located so the organist has clear view of the chancel and the choir.

The console should be seated on a hard surface. If the church is carpeted, then cutting the carpet away several inches from the console and pedalboard to expose a hard surface is recommended. This permits easy disassembly of the console for maintenance, and quick cleaning under the pedalboard or around the console.

For drawknob consoles side jambs angled away from the manuals at 45 degrees are standard for Wicks consoles. Where space is extremely limited, however, narrower angles may be used. Due to the variety of design options and the customizable nature of our consoles, the sizes and weights given here are approximate.

APPROXIMATE SPACE REQUIREMENTS

STYLE	WIDTH	DEPTH	HEIGHT	WEIGHT
Two Manuals Keydesk	5′1″	4′7″	3′8″	300lbs
Two Manuals Stop Key/Tilt Tabs Max 45 stop keys Or 42 Tilt Tabs	6′ 6¾″	5′0″	4′3″	400lbs
Two Manuals Drawknob	6′ 6¾″	5′0″	4′3″	400lbs
Three Manuals Drawknob	6′10″	5′3″	4′8″	700lbs
Four Manuals Drawknob	7′ 10¼″	5′6″	5′1″	900lbs
Five Manuals Draw Knob	7′ 10¼″	5′6″	5′6″	1150lbs

This large blower is adequate for 50 ranks or more. A much smaller version is used for organs up to 20 ranks.

Blower and Power Supply

Every organ includes one or more blowers, which provide wind under pressure; in the case of smaller organs, the blower is often located with the pipework, which saves expense and trouble during installation. The blower area must be arranged so that the air intake will draw tempered air, that is air heated or cooled like that inside the church. This maintains tuning stability of the organ and is preferable over a remote blower installation. The main power supply for the blower(s) is provided by the purchaser. The power supply must be routed through a disconnect to a magnetic starter, and then to the blower(s). Wires, conduit, magnetic starter switch, disconnect switch and electrical connections are all provided by the purchaser. Multiple magnetic starter switches must be provided for multiple blowers if required by local codes. For secondary or booster blowers, a ¾ inch conduit must be provided from the magnetic starter switch to the blower by the purchaser.

A ¾ inch conduit containing 3 number 12 wires serves as the control line from the organ relay to the magnetic starter located in the blower area and to a switched duplex outlet located at the organ relay. Separate conduits must be used for each set of wires if required by local codes. Voltage for these wires is to be determined by an electrician (not to exceed 110 volts A.C.) Wicks will provide a mechanical relay activated by a console key lock switch. The mechanical relay will be inside the organ relay and will activate the magnetic starter switch. Wires from the organ console to the organ relay are included in the main organ cable, but conduits from the console to the organ relays must be provided by the purchaser.

There should be a 2 ½" conduit from the console to each relay area. These conduits are to be stubbed up 3" and capped at each end. The main organ cable is furnished by Wicks. Conduit and installation of the main cable must be provided by the purchaser. Additional conduits are required if there is more than one organ relay. If the organ will include digital ranks, then a 1 inch conduit is required, when the speakers will be outside the main organ area(s), from the digital equipment location to each area where speakers will be located. This conduit and installation of the speaker cable must be provided by the purchaser. The electrical requirements for digital equipment will vary, and one or more duplex outlets will be required.

For each relay location a 20 amp., 110 volt, single phase duplex receptacle must be provided for the rectifier. The rectifier is provided by Wicks and located inside the organ relay. Each organ relay has its own rectifier, and all wiring and connections for the rectifier(s) are provided by Wicks.

The console requires a 20 amp., 110 volt circuit with a quadruplex receptacle located inside the console on a separate circuit, installed by purchaser at the time of organ installation.

The purchaser is required to provide lights and 20 amp., 110 volt duplex receptacles in the organ chamber(s) or case. The number and placement of lights and receptacles should be coordinated with Wicks for convenience and accessability. All wires, conduit and electrical connections are provided by the purchaser.

BLOWER REQUIREMENTS

RANKS	BLOWER SIZE	VOLTAGE/PHASE REQ.	HORSEPOWER	SPACE REQ. CU. FT.
1-2	3/80	110 v/1 phase	.18	12 ft^3
3-9	8/120	110 v or 220 v/1 phase	.45	24 ft^3
10-13	11.3/140	110 v or 220 v/1 phase	.75	48 ft^3
14-20	16.9/152	110 v or 200 v/1 ph. or 3 ph.	1.0	192 ft^3
21-32	28/155	220 v/1 ph. or 3 ph.	2.0	400 ft^{3*}
33-47	40/155	220 v/1 ph. or 3 ph.	3.0	400 ft^{3*}
48-68	58/155	220 v/1 ph. or 3 ph.	4.0	400 ft^{3*}

*Larger Blowers require at least a 7' x 7' x 8' area for static regulator and service access.

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Technical Data And Specifications

Purchaser's Requirements

Wind Conductor Requirements

No wind is required in a Wicks console. Wind conductors are needed only to connect the blower area with the pipework areas because wind is used only for pipe speech. It is never used in a Wicks organ for the action. These wind conductors can be of 26 gauge round galvanized iron, soldered airtight at all joints and seams, or of thin wall PVC plastic pipe glued airtight at all joints. Special attention must be paid to the joints, since even the smallest wind leak will produce unpleasant noises. The blower area should be reasonably close to the organ pipework to minimize the length of air pipe and the electrical conductors. Longer runs require larger sizes. The main windline is the principal wind conductor from the blower to the entire organ. The location for the windline to enter the organ chamber or location should be coordinated with Wicks. It should be stubbed up through the floor or wall at least 12 inches. The main windline is always provided by the purchaser unless noted otherwise by the organ builder. The exact length of the main windline is to be determined by the purchaser. The primary windline(s) tap into windtrunks that are fed by the main windline. They in turn supply wind to the separate divisions of the organ. There can often be more than one primary windline, and their installation should be coordinated with the organ builder. Primary windlines are always provided by the purchaser unless noted otherwise by the organ builder. The secondary windline(s) conduct wind from the windtrunks to the individual pipe organ chests, and can be 3" to 6" in diameter. They are generally of PVC pipe, and are almost always provided by the organ builder, unless the purchaser is notified otherwise. All seams must be airtight.

WIND CONDUCTORS	
RANKS	MINIMUM INSIDE DIAMETER runs under 30'
2 - 6	6 inch
7 - 10	8 inch
11- 20	10 inch
21 - 30	12 inch
31 - 50	14 inch
51 - 65	16 inch
66 - 80	Two 12 inch
81 - 100	Two 14 inch

- For runs over 30 feet in length, increase diameter by 20%.

A windline sleeve is simply an opening in a floor or wall which is at least 2½" larger in diameter than the windline that will pass through it. These sleeves are always required when the organ builder furnishes the actual windlines. The extra size allows for easier installation of the windline(s), and for the passage of organ cables. The location of windline sleeves should be coordinated with the organ builder. Windline sleeves are provided by the purchaser. Local fire codes may regulate the sizes of sleeves. Please check with the codes in your area.

Pipe Areas

Cantilevered supports, platforms, or free-standing pedestals are provided by the purchaser. A nominal weight factor of not less than 75 lbs. per square foot, or 130 lbs. per square foot if the organ is double-decked, is specified for the weight of the organ. **Wicks does not supply structural engineering, installation or materials for these supports.** It is recommended that an additional safety factor be calculated into the weight factors mentioned above by an appropriately qualified person. When applicable, the purchaser is to provide an organ chamber(s) constructed (if new) or modified (if existing) to the organ builder's requirements. All walls and ceilings should be plastered and painted with one coat primer and two coats of enamel hard finish, and floors should be painted with two coats of deck enamel. Outside walls should be insulated against extremes of heat and cold. Air-conditioning and heating ducts should not be located in pipe chambers. The organ builder may supply a drawing illustrating the necessary size, doors and tone openings required for chambers, or a drawing indicating placement and relationship of supports to the organ pipe chests for platforms, supports or pedestals. Electrical and windline preparations may also be illustrated in these drawings.

All electrical and winding requirements listed here are for preliminary project analysis and subject to change depending upon actual organ specification and design.

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How to Build a Bad Room

It is most disappointing to find a well-built organ situated in a room with bad acoustical properties. The organ's natural sounds, as well as the sounds of worshipers or a choir are muffled, altered, or not allowed to travel throughout the room. Building an acoustically bad room is very easy, in fact most of our modern construction techniques aid in removing reverberation from indoor spaces.

Ceiling height is the single most important factor in the acoustic properties of a room. Wide, low roofs push the sound into the floor instead of allowing it to travel into the room. A minimum wall height would be 50 percent of the ceiling width. High A-frame peaked roofs also have the same effect of forcing the sound into the floor, despite their height. Even the use of hard, sealed woods or double layers of sheet rock will be thwarted by a wide, low ceiling, or by too steep a ceiling pitch.

Carpet is the second most important factor in making a room acoustically dead. While carpet has its uses and is very pleasant, the soft surfaces absorb sound rather than letting it reverberate throughout the room. Many churches do well to leave hard surfaces under the congregation and only carpet the aisles, however, it's important to remember that the congregation themselves will serve as absorptive material, and may negate the benefit of the hard surface under the seats. Side aisles should be kept uncarpeted if possible. The meeting of walls and floor is an important location in the acoustics of the room, and carpeting against the wall will deaden reverberant sound before it has a chance to make its way to the back of the room.

Related to carpet is the use of many soft materials. Many churches use thick, soft pads in the pew backs and seats. Any extra absorptive material will prevent the reflection and reverberation of sound. Often overlooked in the same category is the use of soft wood and stone. Porous building materials will often reflect low-frequency sounds while absorbing all upper-frequencies. Sound in a room made of these materials will be very "tubby" and congregational singing will be difficult. Wood and stone can be sealed to help in the reflection of sound. Large expanses of glass will naturally absorb low frequencies, so it is best to avoid very large windows.

A balcony overhanging many seats will create a large acoustic "dead zone". Seats under this balcony will not have access to any of the natural reverberation from the ceiling, especially if the organ or choir are located in the balcony. If doors into the church begin at the balcony edge, then all seats in the church will have access to sound from any source in the room.

False walls, such as retractable, folding walls, or light interior walls will become natural barriers to sound, their flexibility absorbing rather than reflecting sound. Any barriers should be solid, well anchored, and sealed. New to modern construction is the use of metal studs. These light-weight building materials are easy to use and lower fire risks, but often cause noise problems only discovered after construction has been completed. The bass notes of an organ need not be loud to set up sympathetic vibrations within metal-studded walls. This problem can be remedied by applying glue to sheet rock and putting up to four times as many screws into the studs. Rattles may not be confined to just stud walls. Light fixtures, chandeliers, speaker grilles, air conditioning vents, or wiring junction boxes can be set into motion by even the softest sounds of the organ. Measures should be taken during construction to make sure all loose items are attached securely before they are made inaccessible.

Acoustically bad rooms often contain extremes, such as high peaked roofs, large balconies, large windows, or low, wide ceilings. It has been found that traditional shapes are best, even in non-traditional buildings. Many people feel acoustics are above and beyond normal construction techniques, that only the most wealthy can afford acousticians to build room suitable for music and worship. Through careful planning and attention to detail, an acoustically balanced room is not unattainable.

Contact Wicks Organ Company for additional information and assistance.

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