

## Laboratory Planning and Design Manual

Laboratory construction, whether new construction, expansion, or renovation project, it is not only simple to buy the reasonable equipment, but also comprehensive consideration of the overall planning laboratory, rational layout, and graphic design, as well as electricity, water, air, ventilation, air purification, safety, environmental protection, infrastructure and basic conditions. Therefore, the laboratory building is a complicated system, in the modern laboratory, advanced scientific instruments and superior sound lab is to enhance the level of modern technology, a prerequisite for the growth of scientific research. "People-oriented, people and the environment" have become the high concern. "safety, environmental protection, practical, durable, aesthetic, economic, excellence, leadership," is the spirit of the planning design. Planning is divided into six areas: graphic design systems, structure and function of a single design system for the drainage design systems, electronic control systems, special gas distribution system, harmful gases such as six-output system. The following six areas on the order explained above.

### 1, Graphic Design Systems

For graphic design, we mainly consider the following aspects:

1, evacuation, evacuation, escape, smooth, unimpeded and exit; generally laboratory doors is open towards inner, but set an explosive hazard if the room, the door should open outwards, the best material selection pressure glass door.

2, human physiology (and back up work space), the perfect operation of space equipment and technology workers reflects the range of co-ordination with the scientific and humanistic planning.

Doing graphic design, the first factor to consider is the "safety" laboratory is the most vulnerable to cause explosions, fires, gas leaks and other places. We do graphic design at the time, and we should try to maintain the laboratory's ventilation smooth, unobstructed means of escape. According to international ergonomics standards. We make the following classification for reference: (as following)

Experiment set and criteria for the classification test bed channel (channel spacing said with L)

L > 500mm, one side which can be stood to operate for people;

L > 800mm, one side which can be sit to operate for people;

L > 1200mm, one side can be sit while the other side can be stood, but the middle is not extraordinary;

L > 1500mm, the two sides can be sit, the middle can be extraordinary;

L > 1800mm, the two sides can be sit and the middle can be gifted to the apparatus  
Space platforms, instrument sets should not be too close from the wall, 400mm from the wall is appropriate. In order to evacuate easily when the danger happens, passage between bench should all lead to the corridor. In addition: laboratory-storey building should be suitable for the 3.7 m -4.0 m, ceiling height is 2.7 -2.8 m , the clear height of laboratory with clean, pressure gradient, constant temperature and humidity, and other special requirements ,should be 2.5 - 2.7 meters (not including the ceiling); clear width of laboratory corridor is 2.5 m -3.0 m , the width of double doors in ordinary laboratory is 1.1 m -1.5 m (asymmetry of the door), width of a single door 0.8 m -0.9 m.

3, discipline function. Laboratory usually is classified in physics, inorganic chemistry, organic synthetic chemistry, biology. According to the difference of laboratory content, purpose and size, each has its own characteristics, such as basic teaching laboratory. And according to disciplines, mostly relatively simple style of teaching experiments, and they just require simple water and electricity ,but research institutes laboratory ventilation require more water supply and drainage, electric and cleaning, but the basic principles of laboratory design is a commonality, taking organic chemistry as the example, it is made up by chemical, instrumental analysis labs, clean laboratories, computer room, laboratory, ancillary laboratory, room service etc.

Basic chemicals laboratory is used mainly for capacity analysis, ion measurement, such as oxidation and reduction experiments, the general design of the equipment

are: experiment bench and sink bench; fume hood and pipe repair inspection wells; bench with a reagent and auxiliary table, need to consider in laboratory and research space or computer tables, medicine cabinets, tall cabinet, counters, floor placement of instruments and equipment, emergency vehicles.

Instrumental Analysis Laboratory, the main set all kinds of large-scale sophisticated analytical instruments, but also including general small analyzer, the general design of the equipment are: equipment table, bench, fume hood, balance table, computer tables, gas cylinder cabinets, sink bench, tall cabinet, counters, medicine cabinets, first aid devices, universal exhaust hood, atomic absorption enclosures. The following are the requirements for various types of instrumental analysis laboratory, for reference.

Various types of instrumental analysis laboratory request form

The name of laboratory, the room is requested

GC

Analysis of room is for organic compounds which not easily converted into gaseous decomposition and gaseous liquid samples. The main equipment are gas chromatography, with computer control systems and data processing system, a high degree of automation, the separation of organic compounds with high capacity, carrier gas used mainly: H<sub>2</sub>, N<sub>2</sub>, Ar, He, CO<sub>2</sub> and so on. However, compounds with the high boiling point, volatile and difficult thermally unstable compounds, ionic compounds, the separation of polymer is powerless. Local ventilation requirements and avoid direct sunlight on the instrument, to avoid affecting the normal operation of the electric circuit system and magnetic fields exist, the general design: equipment table (in order to maintain the equipment, it should be away from the wall), universal exhaust hood, computer table (usually in the instrument station next to the configuration), edge sets, sink bench, reagent cabinet

Liquid chromatography

Analysis of room is mainly showed in high-efficiency separation, to made the complex organic compounds separate, to pure compounds, quantitative analysis

and qualitative analysis of equipment are: high performance liquid chromatography, suitable for high boiling point compounds, difficult volatile compounds, thermal instability compounds, ionic compounds, polymers, etc., to make up for lack of gas chromatograph. The basis of environmental and laboratory equipment design room with a working knowledge of gas chromatography is similar.

MS Office is mainly qualitative analysis of pure organic matter, to realize molecular weight organic compounds, molecular formula, molecular structure determination, analysis of samples can be gas, liquid, solid, major equipment mass spectrometry, gas chromatography - mass spectrometer. Mass spectrometer is to use electromagnetic principles to material in accordance with the basic characteristics of ion mass to charge ratio (mass  $m$  and charge  $e$  is the ratio- $m / e$ ) to be isolated and analyzed by mass spectrometry instruments and disadvantages of complex organic mixtures separation of powerlessness. Gas chromatography, high efficiency, simple quantitative analysis of the characteristics, combined with mass spectrometry with high sensitivity and the characteristics of strong qualitative analysis of the two instruments, together with the gas chromatography - mass spectrometer. Can learn from each other, improve quality and efficiency analysis. MS may have mercury vapor to escape, to consider local exhaust

Spectrum are mainly based on physical light room with absorption, scattering the physical characteristics and physical properties of light emission, established in analytical chemistry for chemical analysis. The main instrument is the atomic emission spectrometry, atomic absorption spectrometer, spectrophotometer, atomic fluorescence spectrometer, fluorescence spectrometer, X-ray fluorescence analyzer, infrared spectrometer, inductively coupled plasma (LCP) spectroscopy, Raman spectroscopy, and so on. Laboratories should be away from the chemical laboratory, in order to prevent acid, alkali, corrosive gas damage to the instrument, away from the radiation source; room should be dust-proof, vibration, moisture and other measures. Equipment sets and windows, have a certain distance between the wall, to facilitate debugging and maintenance of the equipment. Local exhaust

should be designed. Using atomic absorption is one kind of more appropriate exhaust hood.

These laboratories can be set according to the actual needs of sample handling room, generally sink bench, bench, fume hood and other equipment, with a similar chemical laboratory.

Clean lab mainly through artificial means, the application of clean technology is to control indoor air dust, bacteria concentration, temperature and humidity and pressure, to achieve the required cleanliness, temperature, humidity and air velocity and other environmental parameters. Air cleanliness is the environment, clean air dust concentration level, the level of air cleanliness classification to dust concentration. Per liter of air cleanliness is  $\geq 0.5\mu\text{m}$  particle size contains in the dust of the total particles. Clean air standards in China are divided into four grades: 100, 1000, 10000, 100 000. International standards are divided into: one, two, three, four, five.

#### Clean room

Generally , there are two grades isolation for clean room, one grade isolation is achieved by a biological safety cabinet, negative pressure isolator, positive-pressure protective suits, gloves, goggles, etc.; two grade isolation is achieved by laboratory buildings, air conditioning and electrical control system cleaning . However a small amount of clean air conditioning needed ,For security reasons, all by big wind estimate usually will be passed the standards, especially 100 above, material, hot and cold load is not very demanded strictly ,may estimate, now it is special time, air conditioning unit can be directly used. 2 ~ 4 bio-safety laboratory should implement the two isolation. General laboratory is equipped with: superior Clean cabinet, biological safety cabinets, stainless bench or side bench, such as sink bench.

Taking laboratory as an example to PRC (PCR or polymerase chain reaction) is the molecular biology research and experimentation conventional methods, but also experimental techniques for biology, clinical medicine and other widely used in the

field. It is characterized by small amounts of DNA increased more. Laboratory is usually divided into four areas, namely: reagent storage and preparation areas, sample preparation area, preparation and amplification reaction mixture amplified region of the amplified product analysis area (such as automatic analyzer, the area can be properly combined). Access to all area in one direction must be carried out strictly in accordance with the different work areas with different clothes (such as different colors).

When Staff leaving, shall not take out the work clothes.

Reagent storage and preparation rooms (sample preparation area), the main instrument configuration are: refrigerated centrifuges, biological safety cabinets, refrigerators, portable UV lamp, fully automatic power nucleic acid purification device, special work clothes and work shoes. Amplification reaction mixture preparation and the amplified area is equipped with: refrigerator, high-speed centrifuge, Clean Benches, PCR instrument (requires negative pressure state), removable ultraviolet light, micro pipette, nucleic acid amplification apparatus. Analysis of PCR products of main configurations are: pipette, oscillator, Clean Benches, capillary electrophoresis, refrigerators, centrifuges, micro pipette, mobile UV lights. PCR laboratory design as following below:

#### PCR Lab Plan

Computer room and laboratory, computer are closest with our living ,mainly on air cooling, power supply and so on. Configuration equipped is mainly primarily instrument table with a keyboard. Institute researchers are mainly for local office, so it requires not more, not much to explain here.

Auxiliary Laboratory: mainly balance room, hot room, water room, gas cylinder room, storage room, solution preparation room, darkroom and so on. Balance room, analytical balance is an essential common chemical laboratory equipment, precision scales have certain requirements on the environment, mainly air and wind speed, balance room should be close to the chemical laboratory, to facilitate the use, but not with the high temperature chamber and strong electromagnetic



interference of the room adjacent. High-precision microbalance preferably be located at the bottom. Scale indoor sink bench or not to set any pipe through stifled, so as not to affect the balance of the maintenance of pipeline leaks and use. Room temperature, high temperature furnace and thermostat are standing equipment, the general placed in the high temperature table, but the large constant temperature box to floor placement is appropriate, high-temperature furnace to be separated Peru incubator. Water room, mainly equipped with the experimental design; edge sets and washing station. Greater use of modern laboratory deionized water, and can guarantee a large amount of water quality. Be set up to drain the ground. Cylinder room, laboratory use gas than non-combustible gases (nitrogen, carbon dioxide), inert gases (argon, helium, etc.), other gases with high pressure, highly toxic, oxidative decomposition, explosive or other dangerous gases, such as flammable gases hydrogen, carbon monoxide; toxic gases as fluorine, chlorine; combustion gases such as oxygen, these gases are not laboratory. Tube received by the laboratory. Solution preparation room, for the preparation of a variety of standard solution and different concentrations of the solution. Conditions in the permit may be composed of two rooms, one with space platforms. Another reagent preparation and storage of reagents intercropping purposes, should generally be configured: fume hood, laboratory bench, reagent cabinet.

Services part of the basic laboratory and ancillary laboratory service established, such as water, electric pressure cooker auxiliary rooms and rooms. We just need to know a little.

4, the total number of laboratory staff;

5, apparatus, equipment layout;

6, procedures, processes, professional design;

The first part is Graphic Design, Party A (the user) to show its most basic functional requirements, distribution of program B (the institute), Party C (laboratory planning and design specialist) and the Party involved in the design of laboratory construction Panel to discuss, after three confirmations, then enter the second

process. Because traditional laboratory building design according to national building standards, only the shape and interior structure is the main feature, It is not laboratory-based, architectural design and functional design is out of line. Our company have many lessons in this regard. For example, Guangdong Medical College, signed a two-year contract because the site does not meet the installation conditions, it is not installed.

The second part is a single function, single structure design should be one by one, piece by piece, layer by layer, from the entire complex, stratified, sub-room, single-piece design determine a comprehensive breakdown of recognition;

The third part, all confirmed, invite users to participate in senior leadership Laboratory demonstrations, stand on the spot decision-making; requested by the Party B, Party C the project supervision and strict supervision to install, building standards during the project implementation tracking Laboratory successful completion; construction laboratory planning and design and product tender is divided into two parts; tender: A, designed for the first part; B, the second part of the product standards; building decoration, cleaning, basic equipment, three professional conduct, not confused with the total package, different professions, were tender, and then winning three closely with the decoration and cleaning first, after the laboratory infrastructure to Completion Acceptance of responsibility will be to enter a clear stage, take responsibility for all three the same time focus on completion of inspection, basic equipment, some of for product testing standards, testing and the first two projects are different is not very different from the same treatment.

7, floor, walls, ventilation flow, to prevent dead ends, interior corners as free, easy care, clean.

Second, a single design system structure and function

Different professional private foundation support different laboratory equipment, products divided into five parts: A, part of the experiment station; B, instrument sets part; C, functional cabinet parts; D, equipment parts; E, part of the output system;



A, part of the laboratory bench

1, experiment bench Category:

- ① bench by laboratory functions are divided into: physical test bed (mainly used in electronic, electrical, physical experiments); chemical laboratory bench (mainly for organic, inorganic chemistry experiment); biological laboratory bench (mainly used for purification of sterile experiments, such as the simple anatomical units, stainless steel console, etc.);
- ② According to the structure plan is divided into style: MM (from the steel support frame, the base box, table, reagent racks, connectors, accessories form) MR (base box, table, reagent racks, connectors, accessories form).
- ③-use can be divided into: lab table, side table test sets, washing test bed, reagent rack, the base case, experiment stool.

2, the base case of classification:

Base cabinet can be divided according to material: steel wood-based cabinet, aluminum and wood-based cabinets, all wood-based cabinet.

According to production process is divided into: European-based steel cabinet(that is, to connect the door panel and side panel), steel American-based cabinet (that is, the door panel assembly in the base cabinet)

By models can be divided into: Removable base cabinet, floor-based cabinet, hanging base cabinet. Which movable base cabinets, hanging cabinets for the MM-based models. Floor-based cabinets for the MR section. Steel wooden base cabinet is our newly developed products, siding, door panels for the steel material, other such as laminates, roof, bottom drawer and maintenance are wooden board material, fire safe, cost-effective, glassware .When placed on the advantages of easily broken. Not suitable for production of all wood-based cabinet and hanging washing station.

3, the classification table

The basis of the laboratory equipment in the sale, the table of total offer 1 / 3 share,

the role of the table is evident.

① Press the functional role of bench can be divided into:

Chemistry Table: Anti-acid, alkali, high temperature; resistance to 98% of concentrated sulfuric acid; worktop is made of phenolic resin board

Physics table: anti-static, temperature, sliding, stable strong; 28% of the sulfuric acid-resistant surface is made of fire board

Biological experiments table: waterproof, strong to prevent bacterial density; surface is made of stainless steel.

② material can be divided into panels according to the table and the real core board.

The company used a list of several panels are as follows:

Common plywood Categories

Physical and chemical properties of board (VIA Asia) conventional panels Trespa

Color black, gray black, gray black, gray

Definition of U.S. imports, for the screening of high-quality multi-kraft paper, soaked in a special solution of phenol after thermosetting effect by high pressure forming, with a special corrosion-resistant surface treatment. Dutch imports, composed of 70% wood fiber, 30% of the melamine resin, patented dual beam scanning technology will be attached to the surface layer of melamine, high temperature and pressure molding the company developed products, substrates suppressed by using three high-density board into the surface according to user needs, using a different plate. Have physical, chemical, biological plate divided. Economical and practical, cost-effective.

Table thickness 0.9,6,12.7,14.6,19,25 mm 6,13,16,20,25 mm 45mm

No direct contact with the flame resistance of conventional high-temperature resistant to 140 °C, 180 °C maximum resistance to more than 20 minutes to conventional resistance 140 °C

Characteristics of resistance to chemical reagents, anti-bacterial, anti-impact,

non-conductive, easy to clean and resistant to chemical reagents, anti-bacterial, anti-impact, non-conductive, easy to clean, resistance to abrasion, scratching-resistant, resistant to moisture, UV resistant, easy to maintain resistance to chemical reagents, anti-bacterial, anti-impact, non-conductive, easy to clean, wear-resistant, anti-UV

like use reagent 65% nitric acid, chromic acid, hydrofluoric acid, a slight defect, a defect of 98% sulfuric acid 65% nitric acid, 98% sulfuric acid, uronic slight defects, on 48% hydrofluoric acid with phenolic resin physical defect board can withstand 28% sulfuric acid. Chemical-resistant phenolic resin plate to 98% concentrated sulfuric acid

Test Time 16 hours 24 hours 16 hours

Third, water supply and drainage design system

Drainage design system for the main laboratory for the pre-construction design services. Provide an experimental platform for the Architecture Design Institute under the water of points. Tap into gentle water jet nozzle, single-joint spout (MBs-016) for the jet spout. General with PP sink (MBc-032). Double Tap (MBs-02) for the slow-flow water nozzle, generally with PP sink (MBc-029) specification. In the default configuration we generally give customers double spout. Triple Tap (MBc-01) for the two emergency relief Tap. General with PP sink (MBc-029). Large tank (MBc-031), the fume hood Cup slot (MBc-028).

4, electronic control system

Laboratory electricity include electrical lighting and power electric two parts. Electric power is mainly used for all kinds of electric equipment, elevators, air conditioning and other electricity supply. Laboratory power supply system is the most basic laboratory conditions. Power outlet: 10A, 13A, 16A, 20A; leakage protection switch, overload protection switch. Should be away from the basin and the outlet gas, hydrogen nozzle exit does not affect the test instrument's place and operating position. The main function of steel trunk (mainly for reagent shelves) and PVC trunk with Spain socket (mainly for border stations and CCTV countertop).

## 5, special gas distribution system

Laboratory flammable gas main gas (nitrogen, carbon dioxide), inert gas (argon gas, helium, etc.), flammable gases (hydrogen, carbon monoxide); toxic gases (fluorine, chlorine); combustion gases (oxygen) composition . In addition to flammable gases, inert gases other gases shall not be carried out outside the laboratory. Received by the laboratory pipeline. General Room Configuration helium gas (He), nitrogen (N<sub>2</sub>). Room equipped GC nitrogen, hydrogen, oxygen. Hydrogen pipeline connections should be connected to pipe welding, the possibility of leakage is strictly prohibited. All pipelines must be done after the installation of air tightness test, and before the first use of degreasing. As the small pipe, tube spacing is small, the installation process can be adjusted according to site conditions to ensure the spacing is not less than 45mm, cylinder bottling, the explosive and the inert gas with the cabinet, put an end to two bottles of flammable gas with a cabinet .

## 6, harmful gas output system

There are many laboratories are often not conducive to human health, chemical pollution, especially in hazardous gas, be excluded from very important. At the same time, tend to be a lot of energy consumption, and thus laboratory ventilation control system requirements getting higher, from the early CV (constant air volume) ,2-State (bistable type), VAV (variable air volume) system, adaptive control system to the latest - is safe, but also meet the energy needs. In short, the lab's latest idea is to the laboratory as a fume hood, how to control a variety of intake and exhaust, to achieve safe and economic effects is essential. Laboratory ventilation equipment used are: Fume Hood, atomic absorption cover, universal exhaust hood, ceiling exhaust hood, exhaust hood, etc. on stage. Fume hood in which the most common.

Fume hood is safe disposal of hazardous, toxic gas or steam ventilation function is used to capture, sealing and transfer of pollutants and harmful chemicals, to prevent their escape into the laboratory, so that the work area through the inhalation of pollutants, so far from the operator to achieve the minimization of

inhalation exposure. Fume hood air flow inside the machine through the exhaust air will be sucked into the laboratory fume hood, the fume hood dilution of pollution gases discharged to outside through the exhaust system, you can achieve the low concentration diffusion;

Universal exhaust ventilation hood is first choice for partial: simple installation, location flexibility, ventilation, good performance, can effectively protect the personal safety of laboratory staff;

Atomic absorption shield is mainly applied to various types of large precision instruments, will require a location to install, has set the performance parameters of ventilation, but also the overall laboratory planning one of the factors must be considered;

Exhaust hood is mainly used in chemical laboratories, in addressing the overall ventilation requirements of such laboratories, it is one of the essential equipment. Currently we mainly used mainly axial fan blower (mixed flow fan, duct fans), centrifugal fan. Axial fan suitable for air pressure, suitable for short pipe ventilation system (usually 10 meters, otherwise easily lead to pumping action); centrifugal fan for the ventilation system in the long pipe (usually 10m away, or easily result in noise large). Fan Material: generally divided into fiberglass, PP, PVC, iron, etc., which are more fiberglass. Fans of the models used are based on air volume and pressure to choose.

1, air flow is calculated:

Under the surface wind speed to determine the exhaust volume (face value is generally wind: 0.3 ~ 0.5 m<sup>3</sup> / h)

Formula:  $G = S * V * h * \mu$

$= L * H * 3600 * \mu$

Where G: exhaust volume

S: area of operation to open the window

V: surface wind speed

h: time (1 hour)

L: length Fume Hood

H: Operation window opening height

$\mu$ : safety factor (1.1 ~ 1.2)

Cases: 1200L of the fume hood exhaust volume of its calculation is as follows:

G:  $1.2 * 0.75 / 2 * 0.8 * 3600 * 1.2 = 1555 \text{ m}^3 / \text{h}$

Experience: 1200L fume hood exhaust volume typically  $1500 \text{ m}^3 / \text{h}$

1500L of the fume hood exhaust volume typically  $1800 \text{ m}^3 / \text{h}$

1800L of the fume hood exhaust volume typically  $2000 \text{ m}^3 / \text{h}$

Note: the central platform with exhaust hood exhaust volume fume hood exhaust with the calculation method of calculating the amount

Atomic absorption hood exhaust volume is calculated:

Wind speed determine the population under the hood exhaust volume (cover mouth general values of wind speed:  $1 \sim 2 \text{ m}^3 / \text{h}$ )

Formula:  $G = \pi R^2 * V * 3600 * \mu$

Where G: exhaust volume

R: Cover mouth radius

V: cover mouth wind speed

$\mu$ : safety factor (1.1 ~ 1.2)

Experience: The general atomic absorption hood exhaust volume of  $500 \sim 600 \text{ m}^3 / \text{h}$

Overall exhaust ventilation calculation method

Formula:  $G = V * n * h = L * W * H * n * h$

Where G: Exhaust Volume V: room volume

n: ventilation rate (normally take 8 to 12) h: time (1 hour)

Reference value of air changes

Toxic chemical organic synthesis laboratory experiment P-class biomedical physics experiment

Time / hour 6-2015-1820-30 15-30 5-305-103-8

2, the calculation of wind pressure



Resistance along the pipeline about 5Pa / m, bend resistance at 10 ~ 30 Pa / a, three resistance is 30 ~ 50 Pa / month.

Note: All resistance and multiplied by the factor of safety (1.1 ~ 1.2) is the pressure value.

3, the calculation of air volume ventilation pipe

Note: Generally, the national standards of the duct velocity range from  $V = 6 \sim 8 \text{ m / s}$  (corporate computing standard of the duct velocity range from  $V = 8 \sim 12 \text{ m / s}$ )

Formula:  $G = S \cdot V \cdot 3600 = \pi R^2 \cdot V \cdot 3600 \rightarrow R = [G / (\pi \cdot V \cdot 3600)]^{1/2}$

Where G: exhaust volume (calculated according to the above) R: Duct radius V: Duct velocity

Note: the size of rectangular duct There are several

fixed-size: 120,150,200,250,300,400,500,630,800,1000,1200,1400,1600,1800 (For the circular tube into rectangular pipe, the design principle is the same area)

Part of the ventilation pipe of the air volume calculated reference value

Type Size (mm) exhaust volume  $\text{m}^3 / \text{h}$

Round Duct :  $\Phi 160$  578.76

$\Phi 200$  904.32

$\Phi 300$  2034.72

$\Phi 400$  3617.28

Rectangle Duct: 200 \* 200 1152

300 \* 300 2592

400 \* 400 4608

4, fan model reference

FRP Axial Fan Reference Model

Machine	Model (No.)	Speed (r / min)	flow Volume	Flow (M3 / h)	Total Pressure (pa)	Power (kw)
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2900	1130.4-2271.6	2.5 125 - 184	0.09-0.18			
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1450	565.2-1141.2	31 - 46	0.025-0.25			
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32900	1951.2-3931.2	180 - 266	0.180-0.550			
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1450 975.6-1958.4 45 - 67 0.09-0.09

2900 3099.6-6238.8 3.5 245 - 363 0.370-1.1

1450 1551.6-3121.2 62 - 90 0.06-0.12

42900 4629.6-9309.6 321 - 473 1.1-2.2

1450 2318.4-4658.4 80 - 119 0.25-0.25

51450 4521.6-9090.0 125 - 184 0.75-0.75

960 2991.6—6019.2 54--81 0.25—0.25

6 1450 7808.4—15699.6 180--267 1.1—2.2

960 5158.8—10400.4 79--117 0.75—0.75

7 1450 12398.4—24998.4 245-363 1.5—4

960 8200.8—16498.8 108--159 0.75—1.1

8 1450 18500.4--32200 321--473 3—7.5

960 12301.2—24699.6 140-208 1.1—2.2

9 960 12398.8--35100 177--263 1.5—4

Model(No.) Speed(r/min) Volume Flow(M3/h) Total Pressure(pa) Power (kw)

2.8A 2900 1330--2450 950--588 1.5

1450 665--1225 236--147 0.75

3.2A 2900 1975--3640 1244--784 2.2

1450 991--1910 313--196 1.1

3.6A 2900 2930--5408 1617--1068 3.0

1450 1470--2710 401--274 1.1

4A 2900 4020--7420 1999--1313 5.5

1450 2010--3710 499--333 1.1

4. 5A 2900 5730--10580 2528-1666 7. 5

1450 2860--5280 637--421 1. 1

5A 2900 7728--15455 3187--2019 15

1450 3977--7358 794--548 2. 2

6A 1450 6840--12720 1136--784 4. 0

960 4520--8370 499--343 1. 5

6C 2240 11818--20628 2698--1733 15

2000 10552--18418 2147--1380 11

1800 9497--16576 1736--1116 7. 5

1600 8442--14737 1370--881 5. 5

1250 6595--11500 835--537 3. 0

1120 5909--10314 670--431 2. 2

1000 5276--9209 534--344 2. 2

900 4749--8288 432--278 1. 5

8 C 1800 25240--36427 3032--2302 37

1800 19646--22511 3143--3101 30

1600 24982--32380 2303--1816 30

1600 17463--22435 2478--2390 2. 2

1250 13643--25297 1507--1106 11

1120 17487--22666 1124--887 11

1120 12224--15705 1209--1166 7. 5

1000 15614--20237 895--707 7. 5

1000 10914--14022 963--929 5.5

900 14052--18213 725--572 5.5

900 9823--12620 779--752 4

8C 800 8732--16190 615--452 3

710 7749--14368 485--356 2.2

FRP centrifugal fan Reference Model

FRP diagonal flow fans Reference Model

Machine ID Model (No.) Speed (r / min) Volume Flow (M3 / h) Total Pressure (pa)

Power (kw)

2.0F 1450 180 - 780 110 - 25 YS-5024 - 0.04

2.5F 1450 360 - 1500 175 - 50 YS-5624-0.09

3.0F 1450 600 - 2520 250 - 80 YS-6324-0.18

3.5S 960 600 - 2520 150 - 50 YS-7116-0.18

3.5F 1450 2220--4020 340 - 100 YS-7124-0.37

4.0S 960 900 - 4020 200 - 60 YS-7126-0.25

4.0F 1450 1500--5160 440 - 200 Y8024-0.75

4.5S 960 1260 - 4980 250 - 100 Y8016-0.37

4.5F 1450 1980--7980 560 - 200 Y90S4-1.1

5.0S 960 2280 - 7020 300 - 100 Y90S-6-0.75

5.0F 1450 2420-9480 700 -300 Y100L-4-2.2

6.0S 960 2520 - 10200 500 - 200 Y100L-6-1.5

6.0F 1450 7020 - 11580 900 - 300 Y132S-4-5.5

7.0S 960 4020 - 11400 600 - 300 Y132S-6-3.0

8.0S1 960 4980 - 25020 800-400 Y132M-6-5.5

8.0S2 960 7980 - 30000 850 - 400 Y160M-6-7.5

8.0E 720 6000 - 22980 700-300 Y160M-8-4.0