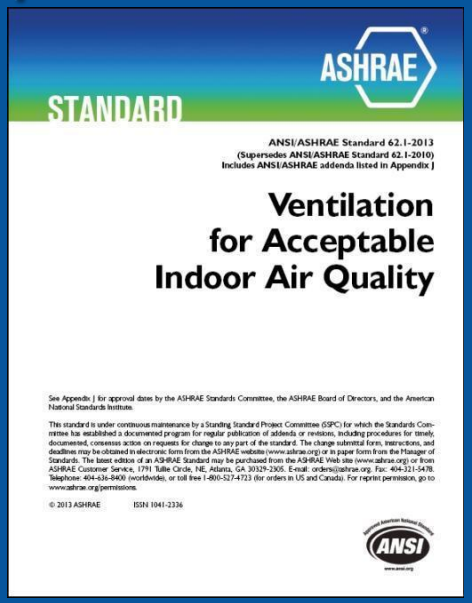
ASHRAE Std 62.1-2010/2019 Ventilación para una Aceptable Calidad del Aire Interior



Calidad Aceptable del Aire Interior

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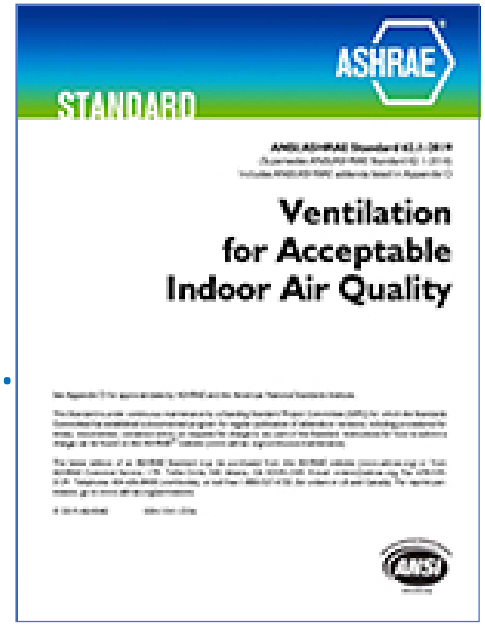
Calidad Aceptable del Aire Interior

Aire en el cual no se conocen contaminantes en concentraciones nocivas de acuerdo a lo determinado por las autoridades competentes y en el cual una gran mayoría de las personas expuestas (80% o más) no expresan insatisfacción.

Standard ASHRAE 62.1 Y Actividades Relacionadas...

- Está en permanente revisión, con una edición nueva cada tres años.
- La última versión del Standard 62.1 es la 2019.
- USGBC lo toma como Standard exigido para cumplir con la Certificación LEED.
- Existen cursos de aplicación en la página de ASHRAE.

https://www.ashrae.org/professional-development/elearning-on-demand



62.1 – Propósito

1.1 – Establecer caudales mínimos de ventilación y otras medidas destinadas a proveer una Calidad del Aire Interior aceptable para los ocupantes y minimizar los efectos adversos para la salud.

1.2 – De aplicación reglamentaria en Edificios nuevos y Ampliaciones.

1.3- Guiar el mejoramiento del aire interior en Edificios existentes.

62.1 – Alcance

2.1 – A todos los espacios que son ocupados por personas excluyendo a edificios de baja altura. (Standard 62.2).

2.2 – Define requisitos de ventilación, diseño, limpieza del aire, comisionamiento, instalación y operación y mantenimiento.

2.3- Puede requerirse la aplicación de otros Standards o Handbooks. (Laboratorios, Centros de Salud, Industria, etc.)

62.1 – Alcance, cont.

2.4 – Se puede aplicar a edificios nuevos y existentes.

2.5 – No especifica caudales de ventilación en espacios en los cuales se permita fumar.

2.6 – Los cálculos de los caudales de ventilación están basados en contaminantes químicos, físicos y biológicos en cada uno de los espacios.

2.7 – No incluyen verificación o control del confort térmico. Este aspecto está cubierto por el Stanadard 55.

Requisitos Generales – Calidad del Aire Exterior
Sección 4

Se deben observar y documentar los siguientes elementos:

- Tipo de construcción a evaluar y su entorno.
- Presencia de olores o elementos irritantes del olfato o la vista.
- Presencia de humos o contaminantes.
- Presencia de gases de combustión de vehículos.
- Presencia de fuentes potenciales de contaminación.

Requisitos Generales – Calidad del Aire Exterior
Sección 4

Se deberá verificar la calidad del aire exterior en los alrededores del Edificio durante los horarios normales de funcionamiento, indicando día y hora de las observaciones.

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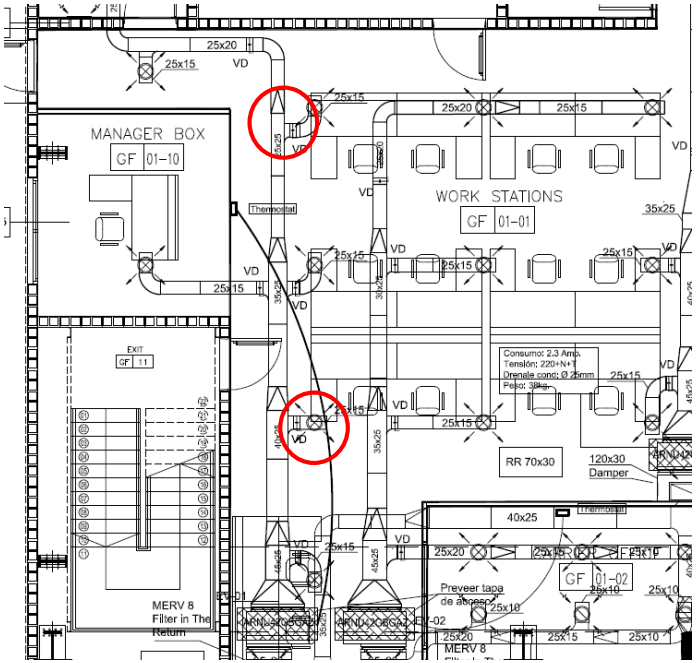
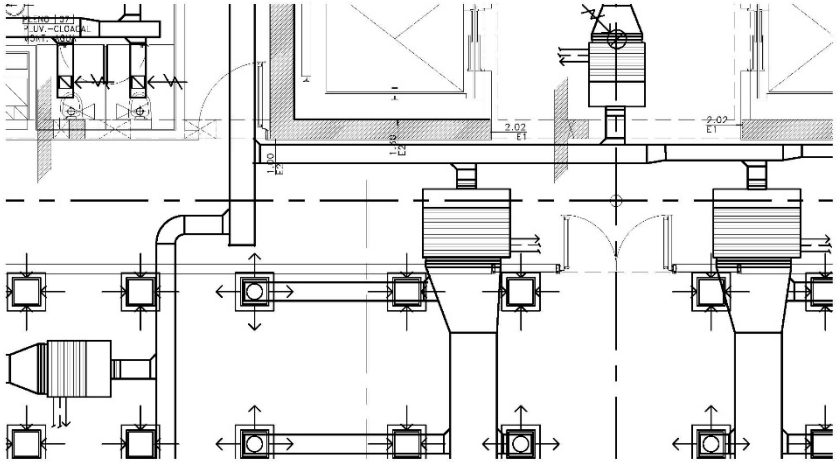
Requisitos Generales – Sistemas y Equipamiento - Sección 5

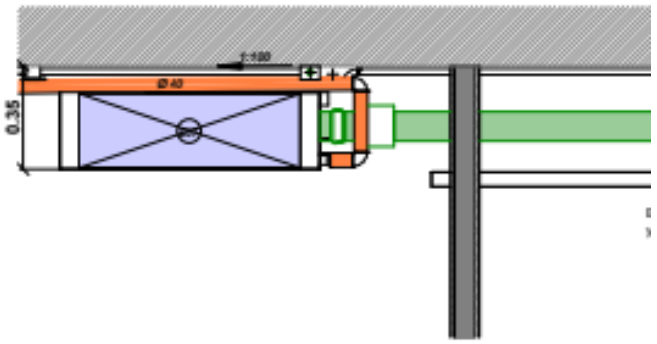
5.1- Distribución del Aire de Ventilación.



Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.1- Distribución del Aire de Ventilación.





Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.2- Ubicación de los Conductos de Extracción.

- Los conductos de extracción que transporten aire con contaminantes potencialmente dañinos para la salud deben trabajar a presión negativa.

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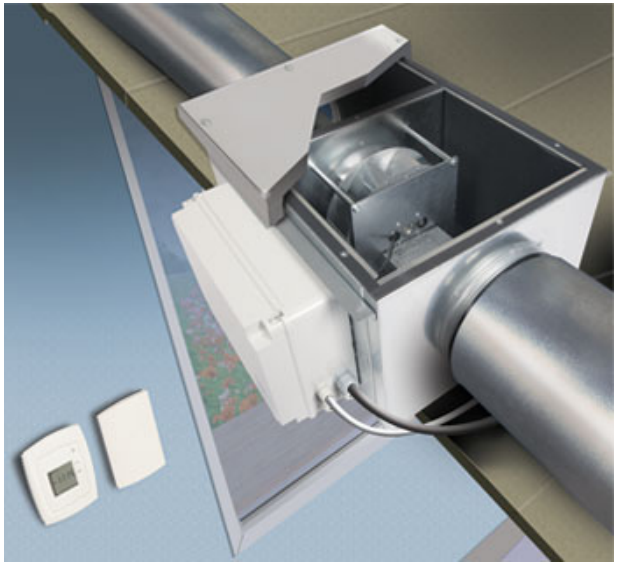
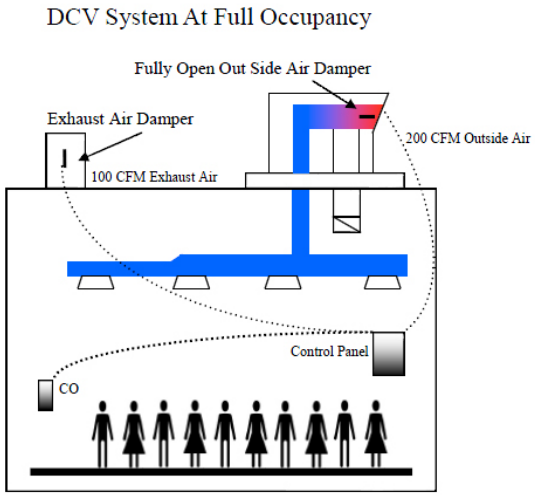
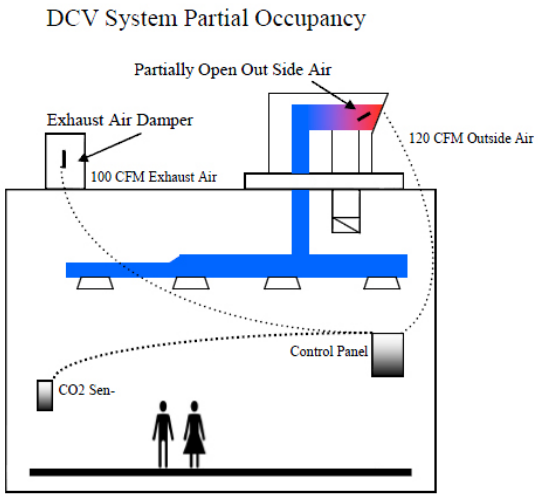
Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.3- Control de los Sistemas de Ventilación.

- Los controles deben asegurar la ventilación apropiada bajo cualquier condición de operación.







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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.4- Superficies en la Corriente de Aire.

- Usar materiales que cuenten con resistencia documentada contra el crecimiento de hongos y bacterias y erosión.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.5- Tomas de Aire Exterior.

- Separar las TAE de fuentes de contaminación exteriores.
- Deben cumplir con las separaciones mínimas indicadas en la Tabla 5-1.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

TABLE 5-1 Air Intake Minimum Separation Distance

Object	Minimum Distance, ft (m)
Class 2 air exhaust/relief outlet (Note 1)	10 (3)
Class 3 air exhaust/relief outlet (Note 1)	15 (5)
Class 4 air exhaust/relief outlet (Note 2)	30 (10)
Plumbing vents terminating less than 3 ft (1 m) above the level of the outdoor air intake	10 (3)
Plumbing vents terminating at least 3 ft (1 m) above the level of the outdoor air intake	3 (1)
Vents, chimneys, and flues from combustion appliances and equipment (Note 3)	15 (5)
Garage entry, automobile loading area, or drive-in queue (Note 4)	15 (5)
Truck loading area or dock, bus parking/idling area (Note 4)	25 (7.5)
Driveway, street, or parking place (Note 4)	5 (1.5)
Thoroughfare with high traffic volume	25 (7.5)
Roof, landscaped grade, or other surface directly below intake (Notes 5 and 6)	1 (0.30)
Garbage storage/pick-up area, dumpsters	15 (5)
Cooling tower intake or basin	15 (5)
Cooling tower exhaust	25 (7.5)

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.5- Tomas de Aire Exterior.

- Entrada de agua de lluvia.

Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.5- Tomas de Aire Exterior.

- Entrada de pájaros.

Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.8- Utilizar filtros mínimo MERV 8 aguas arriba de las serpentinas de enfriamiento y otras superficies húmedas.

Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.10- Bandejas de Condensado..

- Asegurar que no se produzcan derrames de la bandeja de condensado.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.13- Acceso para Inspección, Limpieza y Mantenimiento.

Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.13- Acceso para Inspección, Limpieza y Mantenimiento.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.16- Clasificación del Aire y Recirculación.

- Clasificación del aire de retorno, transferencia o extracción, de acuerdo a sus containantes.
- Clase 1: Concentración baja de contaminantes.
- Clase 2: Concentración moderada.
- Clase 3: Concentración significativa.
- Clase 4: Concentración alta o potencialmente dañina.
- Tabla 5.2, 6.1 y 6.4.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.16- Clasificación del Aire y Recirculación.

- El aire se puede recircular de acuerdo a su clasificación:
- Clase 1: A espacios con cualquier clase de aire.
- Clase 2: A espacios de su misma clase, o de Clases 3 o 4.
- Clase 3: A espacios de su misma clase.
- Clase 4: Sólo al exterior.

Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.17- Requisitos en Edificios con áreas ETS y no-ETS.

- LOS LOCALES ETS NO CUMPLEN CON IAQ ACEPTABLES.
- Se deben clasificar los espacios como ETS o no-ETS.
- Los espacios no-ETS deben estar a presión positiva respecto a espacios definidos como ETS.
- Los espacios ETS deben estar separados por muros, pisos, cielorrasos sólidos, con puertas de cierre automático.

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Requisitos Generales – Sistemas y Equipamiento - Sección 5

5.17- Requisitos en Edificios con áreas ETS y no-ETS - cont.

- No se permite la recirculación o transferencia de aire entre espacios ETS y no-ETS.
- Los espacios ETS deben extraerse al exterior.

Requisitos de Ventilación – Procedimientos

Sección 6 – Cálculo de Caudal de Aire Exterior

- Ventilation Rate Procedure - VRP.

Indica tasas y procedimientos de cálculo basado en contaminantes típicos para cada uno de los espacios.

- Indoor Air Quality Procedure – IAQ.

Requiere de cálculos basados en el análisis de las fuentes contaminantes, la concentración y percepción de los ocupantes.

- Natural Ventilation Procedure – NV.

Indica criterios para ventilación de espacios en forma natural, a través de aberturas hacia el exterior.

Requisitos de Ventilación – Procedimientos

Sección 6 – Cálculo de Caudal de Aire Exterior.

- DESDE LA VERSIÓN 2010.

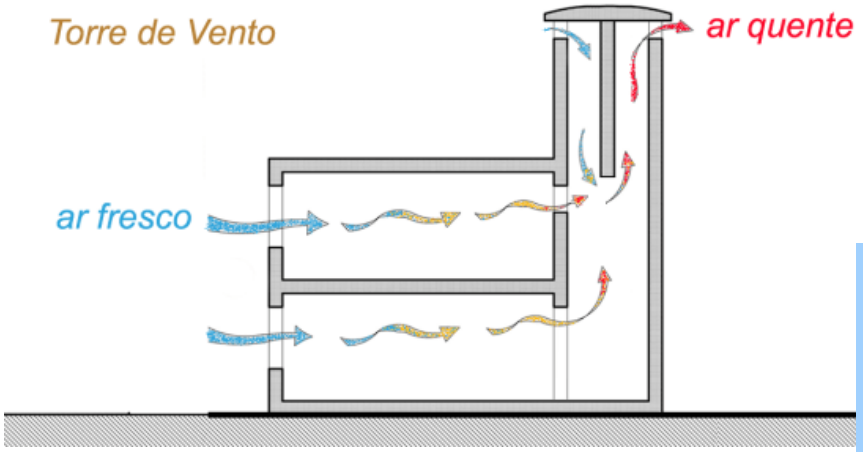
NUEVO

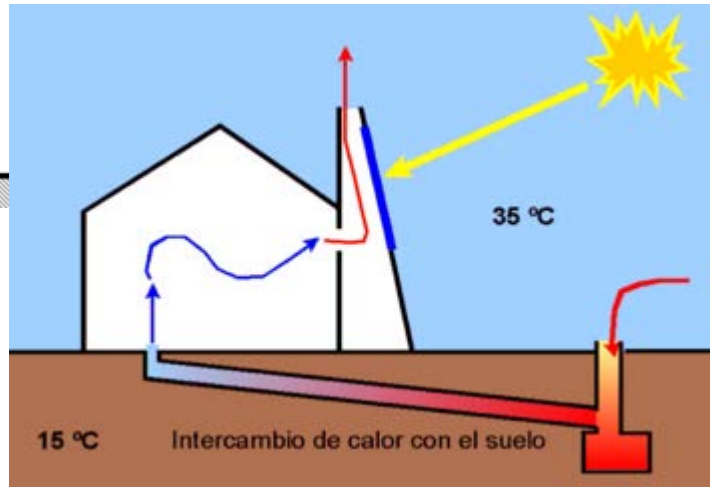
Los locales que cuenten con ventilación natural de acuerdo al presente Standard, deberán incluir ventilación mecánica de acuerdo a 6.2 o 6.3, excepto:

- Sistema de Ventilación Natural de Ingeniería.
- Las aberturas son permanentes o poseen controles que impiden su cierre durante la ocupación.
- La zona no cuenta con calefacción ni acondicionamiento de aire.

Requisitos de Ventilación – Procedimientos

Sección 6 – Cálculo de Caudal de Aire Exterior.





Requisitos de Ventilación – Procedimientos

Sección 6 – Cálculo de Caudal de Aire Exterior.

Sección 6 - VRP.

NUEVO – Tabla I-1

Tratamiento del Aire Exterior – Nuevo desde 2010

Si el aire exterior no es aceptable de acuerdo a 4.1.

- Contenido máximo de partículas menores a 10 micrones - PM10 – MERV 6.

- Contenido máximo de partículas menores a 2,5 micrones – PM2.5 – MERV 11.

- Contenido máximo de ozono para concentraciones mayores a 0.107 ppm.

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ASHRAE CELEBRATING 125 YEARS

Sección 6 - VRP.

- 1 -

Conocer el Destino y la Superficie del Local y la Cantidad de Personas que lo Ocuparán.

VRP

CAUDAL DE AIRE EXTERIOR EN LA ZONA DE RESPIRACIÓN

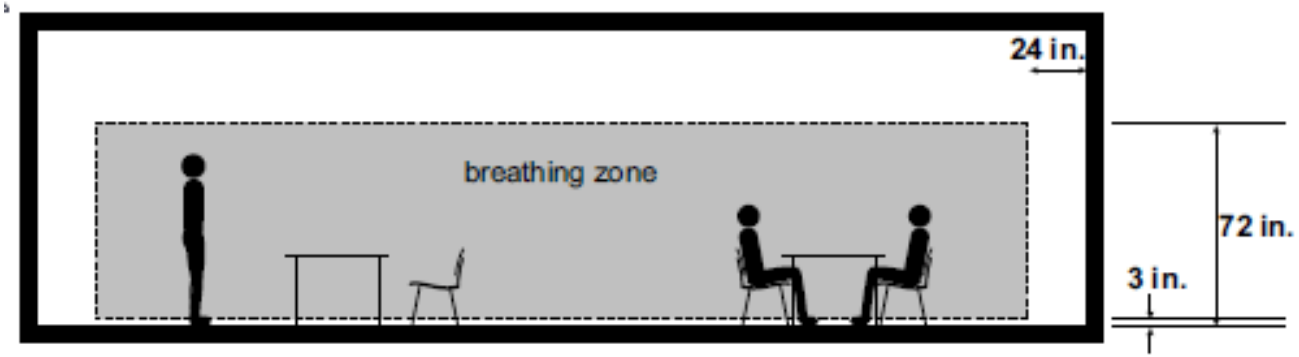
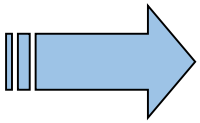


Figure 6-A—Breathing Zone

$$V_{bz} = R_p \times P_z + R_a \times A_z$$

VRP



CANTIDAD DE PERSONAS
Pz

USO DEL LOCAL

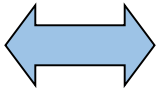
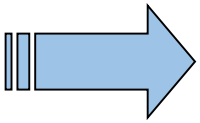


TABLA 6-1
Vbz



AREA DEL LOCAL
Az

$$Vbz = Pz \times Rp + Az \times Ra$$

VRP

TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE *(continued)*
(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

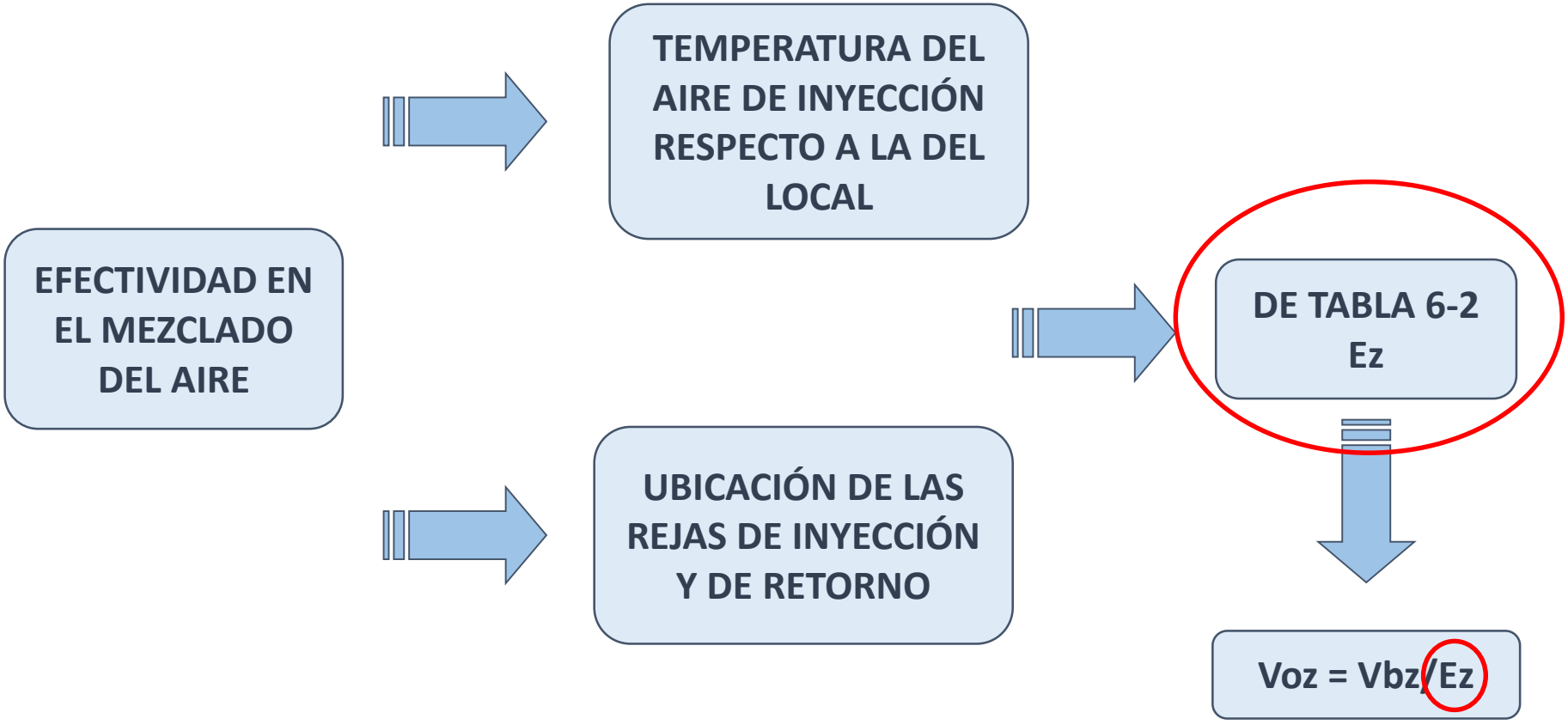
Occupancy Category	People Outdoor Air Rate R_p		Area Outdoor Air Rate R_a		Notes	Default Values			Air Class
						Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
	cfm/person	L/s·person	cfm/ft²	L/s·m²		#/1000 ft² or #/100 m²	cfm/person	L/s·person	
Office Buildings									
Office space	5	2.5	0.06	0.3		5	17	8.5	1
Reception areas	5	2.5	0.06	0.3		30	7	3.5	1
Telephone/data entry	5	2.5	0.06	0.3		60	6	3.0	1
Main entry lobbies	5	2.5	0.06	0.3		10	11	5.5	1
Miscellaneous Spaces									
Bank vaults/safe deposit	5	2.5	0.06	0.3		5	17	8.5	2
Computer (not printing)	5	2.5	0.06	0.3		4	20	10.0	1
Electrical equipment rooms	–	–	0.06	0.3	B	–			1
Elevator machine rooms	–	–	0.12	0.6	B	–			1
Pharmacy (prep. area)	5	2.5	0.18	0.9		10	23	11.5	2
Photo studios	5	2.5	0.12	0.6		10	17	8.5	1
Shipping/receiving	–	–	0.12	0.6	B	–			1
Telephone closets	–	–	0.00	0.0		–			1
Transportation waiting	7.5	3.8	0.06	0.3		100	8	4.1	1
Warehouses	–	–	0.06	0.3	B	–			2

VRP

- 2 -

Saber Cómo se Mezcla el Aire de Inyección con el Aire del Local.

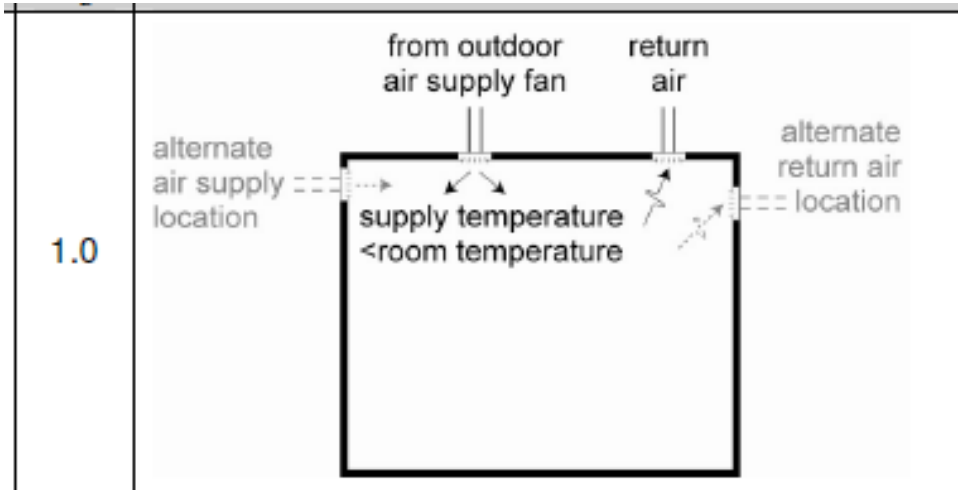
VRP

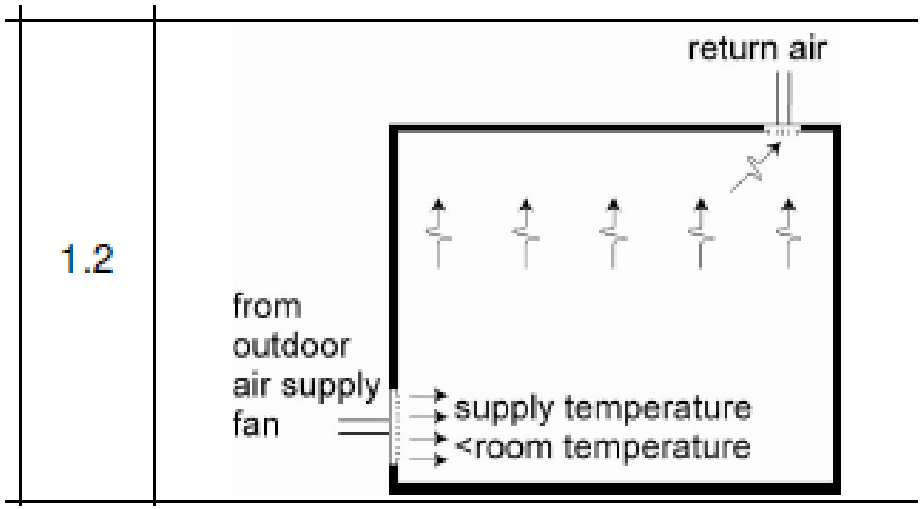

TEMPERATURA DEL AIRE DE INYECCIÓN RESPECTO A LA DEL LOCAL
EFECTIVIDAD EN EL MEZCLADO DEL AIRE
DE TABLA 6-2 Ez
UBICACIÓN DE LAS REJAS DE INYECCIÓN Y DE RETORNO
Voz = Vbz/Ez
Ez > 1, = 1, < 1

VRP

Valores de Ez

Aire Inyectado a Menor Temperatura que el Aire del Local

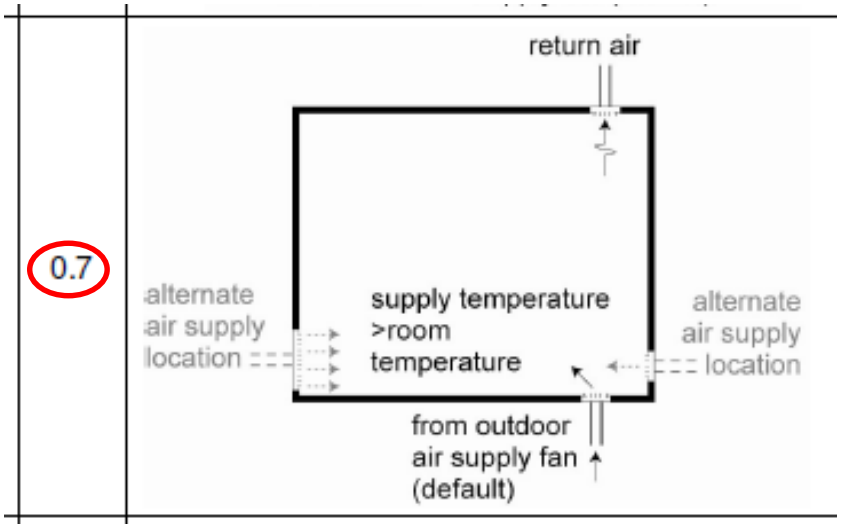


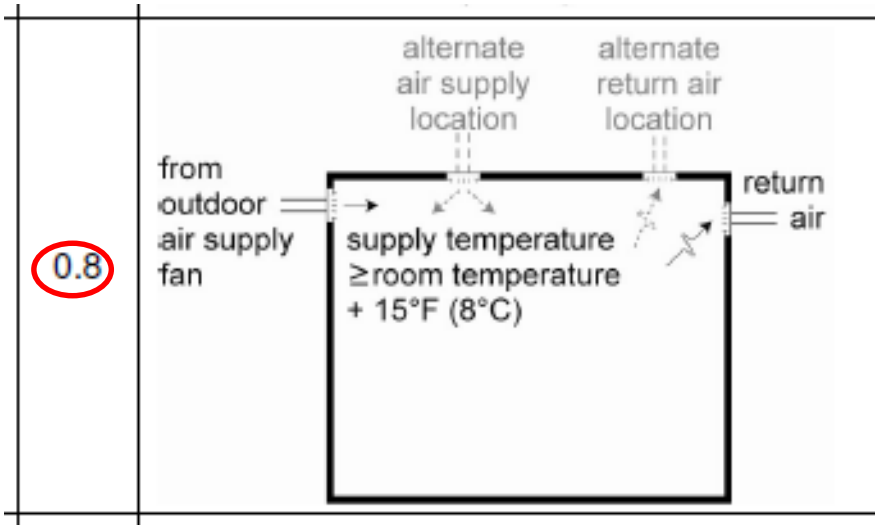


VRP

Valores de Ez

Aire Inyectado a Mayor Temperatura que el Aire del Local



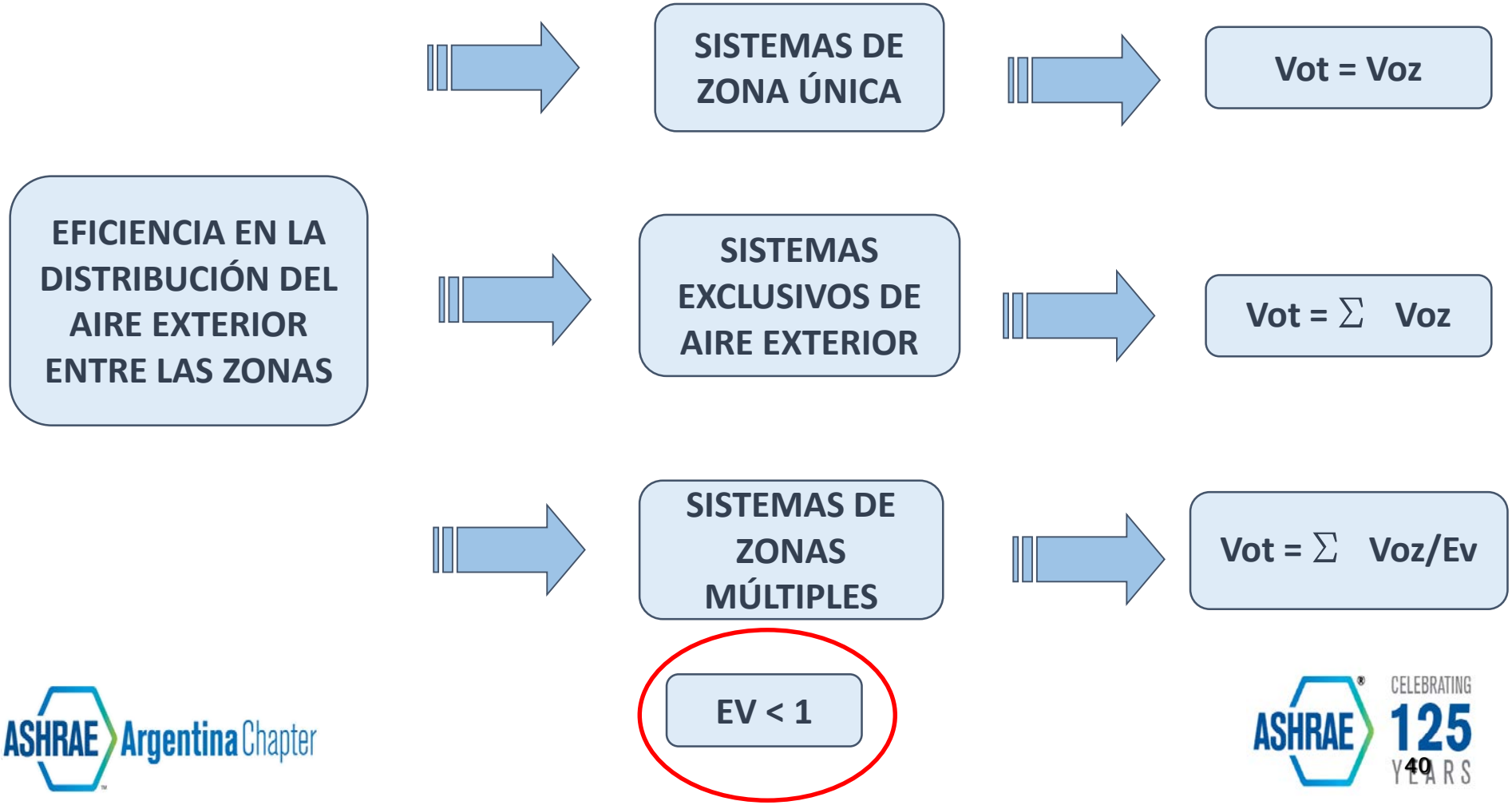


VRP

- 3 -

Conocer el Tipo de Sistema a través del cual se Inyectará el Aire Exterior.

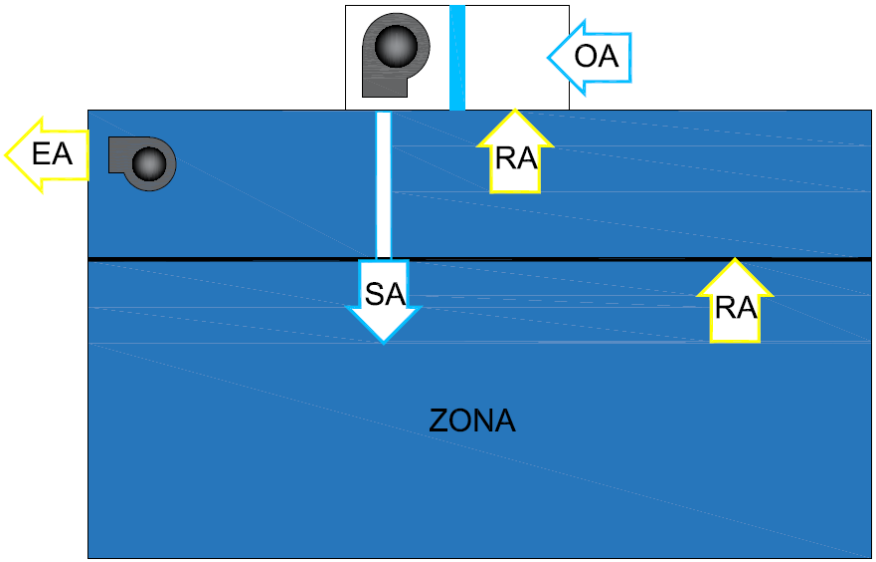
VRP


EFICIENCIA EN LA DISTRIBUCIÓN DEL AIRE EXTERIOR ENTRE LAS ZONAS
SISTEMAS DE ZONA ÚNICA
Vot = Voz
SISTEMAS EXCLUSIVOS DE AIRE EXTERIOR
Vot = ∑ Voz
SISTEMAS DE ZONAS MÚLTIPLES
Vot = ∑ Voz/Ev
EV < 1

VRP – Sistema de Zona Única

Sistemas de Zona Única

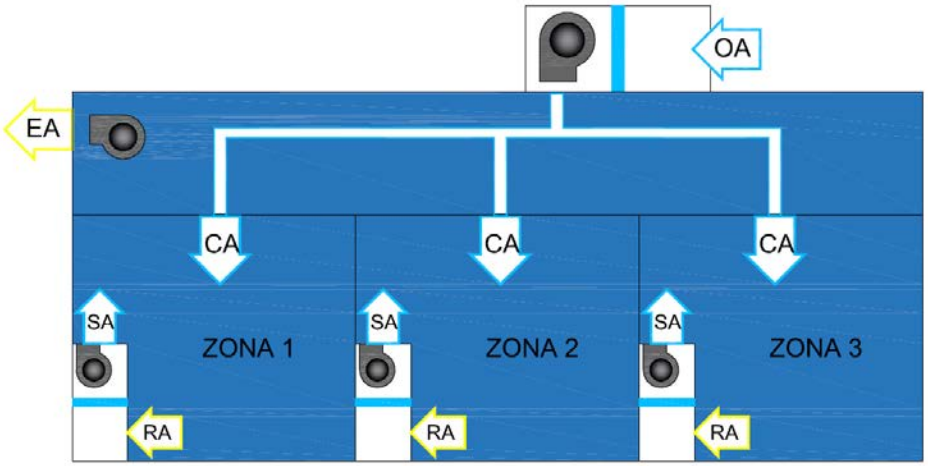
Vot = Voz



VRP – 100% Aire Exterior

Sistemas 100% De Aire Exterior

Vot = $\sum$ Voz *todas las zonas*



VRP – Sistemas de Zonas Múltiples

Fracción de Aire Primario

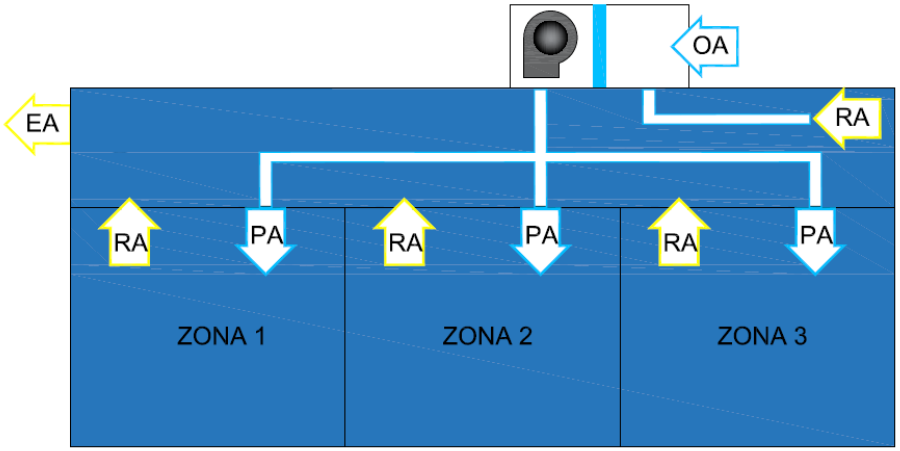
Zpz1 = Voz1/Vpz1

Zpz2 = Voz2/Vpz2

Zpz3 = Voz3/Vpz3

Vpz

Caudal Primario Mínimo en la Zona para la Condición Analizada



Vot = Voz/Ez MIN

Ez < 1

VRP – Sistemas de Zonas Múltiples

Condición Analizada	**Evaluar en enfriamiento y en calefacción**
Caudal Primario	**Incluye aire exterior y aire de retorno de la Zona.**
Mínimo	**Para la condición analizada, el menor caudal primario en la zona. Con la menor carga interna y máxima ocupación.**

Zona Crítica = Zona con menor Caudal Primario

VRP – Sistemas de Zonas Múltiples

Fracción de Aire Primario

Zpz = Voz/Vpz

Vpz

Caudal Primario Mínimo en la Zona para la Condición Analizada

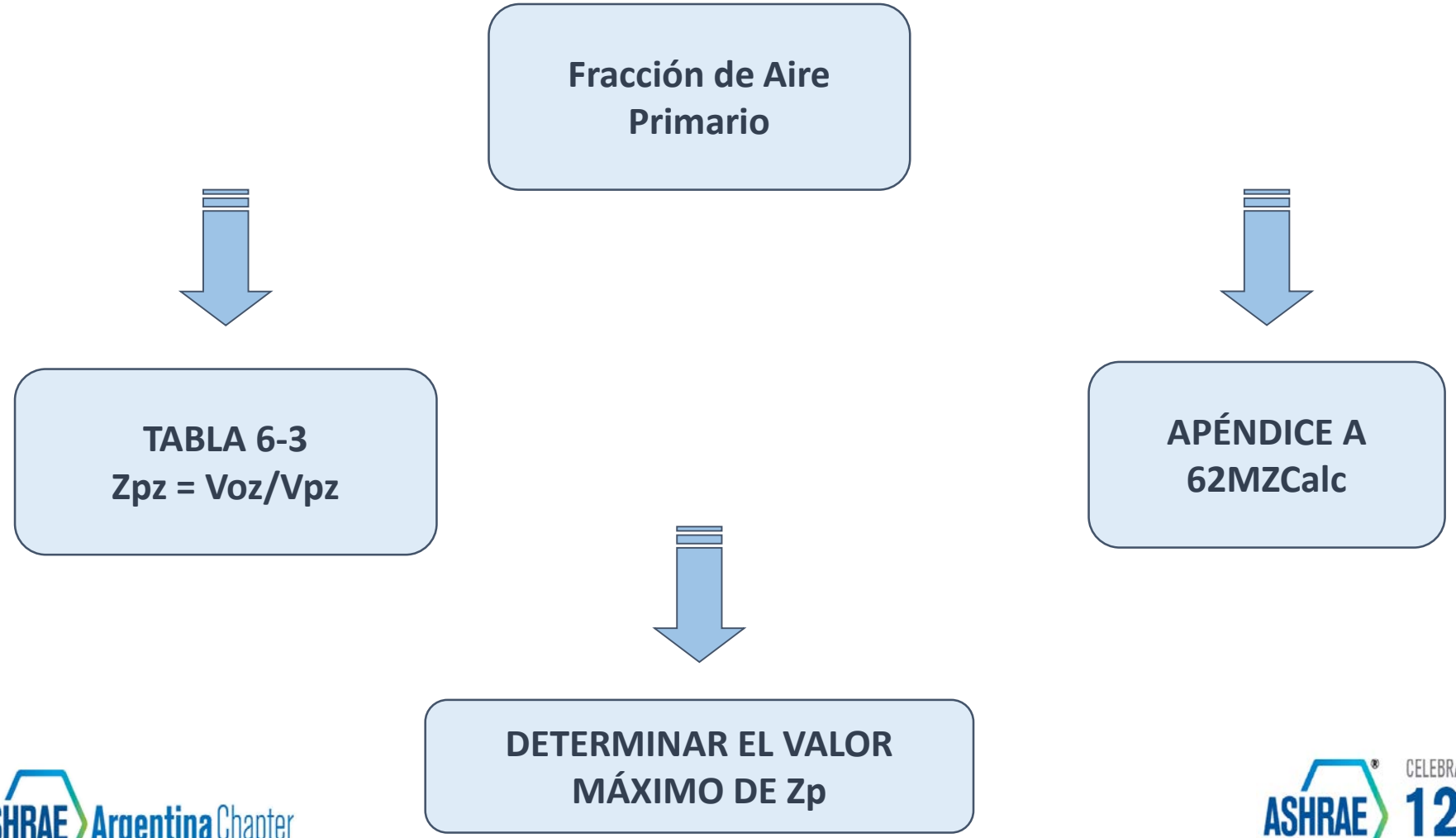
Vpz ↓ **Zpz** ↑ **Ez < 1** ↓

Vot = Voz/Ez ↑

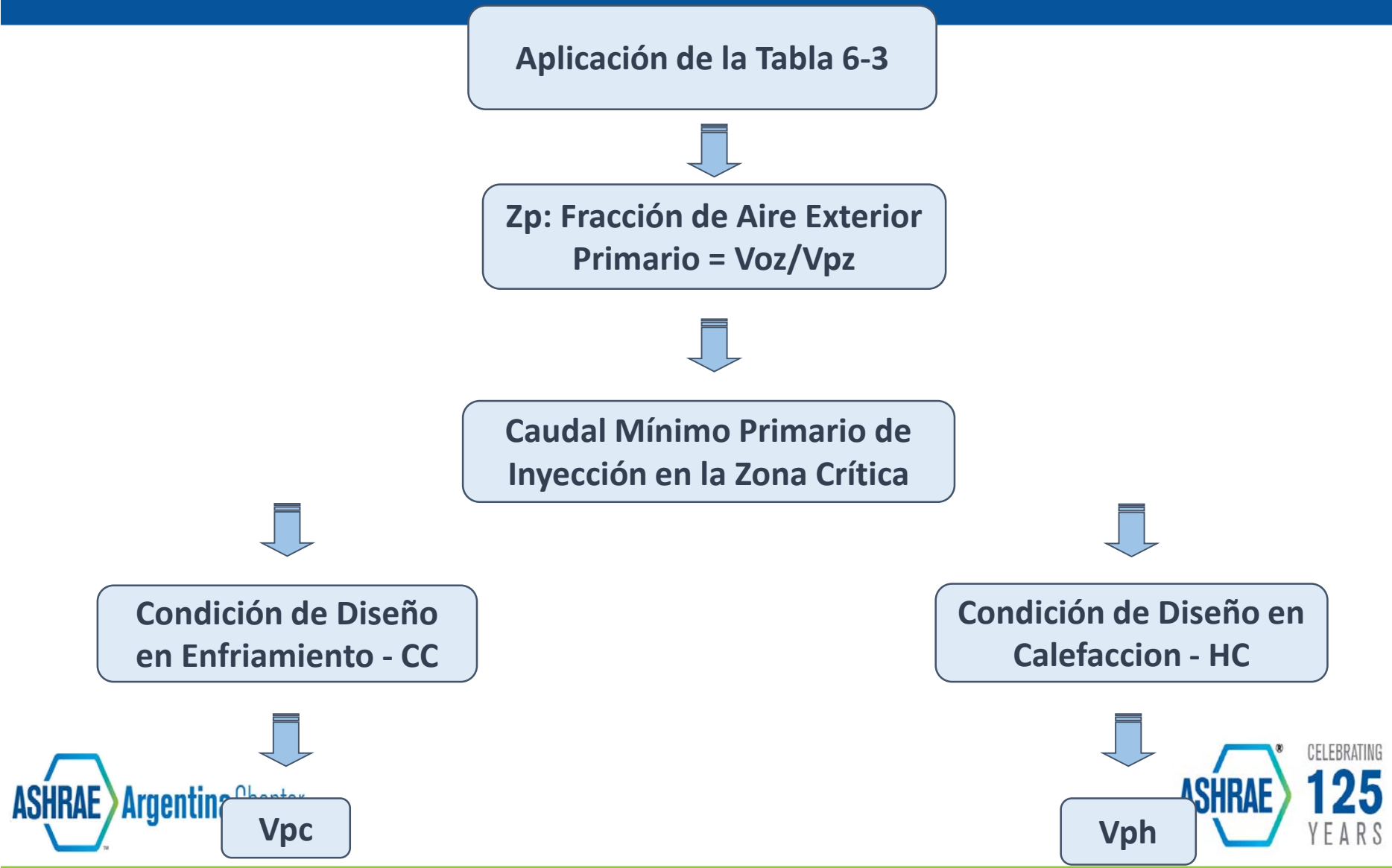
VRP – Sistema de Zonas Múltiples

CÓMO SE OBTIENE EL VALOR DE EZ

VRP – Sistema de Zonas Múltiples



VRP – Sistemas de Zonas Múltiples



VRP – Sistemas de Zonas Múltiples

CON EL MAYOR Zp DETRMINAMOS EL MENOR Ev DE TABLA 6-3

TABLE 6-3 System Ventilation Efficiency

Max (Z_p)	E_v
≤0.15	1.0
≤0.25	0.9
≤0.35	0.8
≤0.45	0.7
≤0.55	0.6
>0.55	Use Appendix A

1. "Max (Z_{pz})" refers to the largest value of Z_{pz}, calculated using Equation 6-5, among all the *ventilation zones* served by the system.
2. For values of Max (Z_{pz}) between 0.15 and 0.55, the corresponding value of E_v may be determined by interpolating the values in the table.
3. The values of E_v in this table are based on a 0.15 average outdoor air fraction for the system (i.e., the ratio of the uncorrected outdoor air intake (V_{ou}) to the total zone primary airflow for all the zones served by the air handler). For systems with higher values of the average outdoor air fraction, this table may result in unrealistically low values of E_v and the use of Appendix A may yield more practical results.

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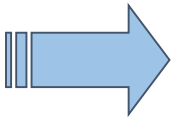
Con Ev



Vot = Vou / Ev

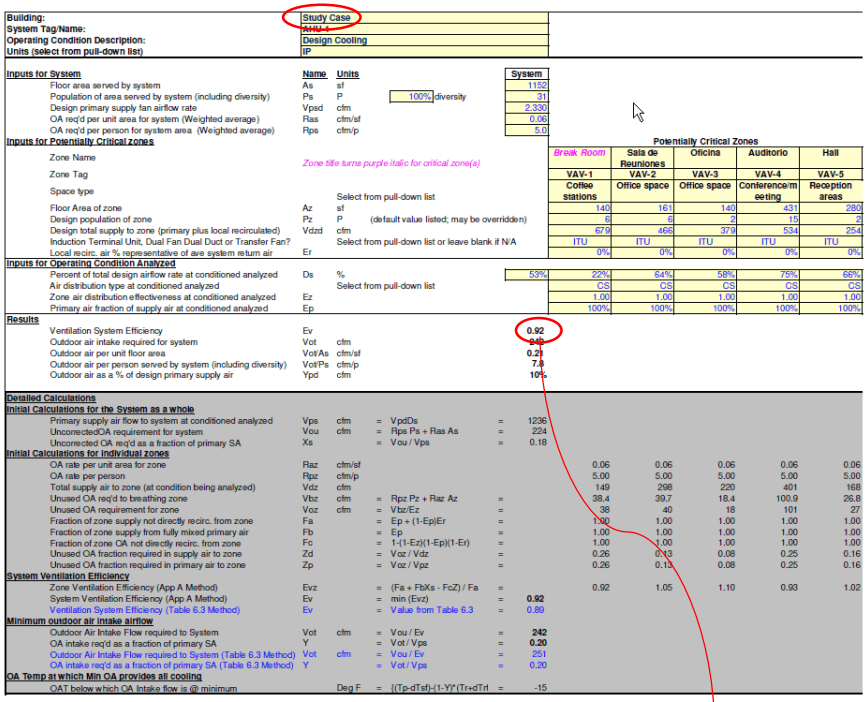
Vou = D $\sum$ (Rp x Pz) + (Ra x Az)

VRP – Sistemas de Zonas Múltiples

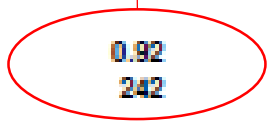
Aplicación del 62MZCalc

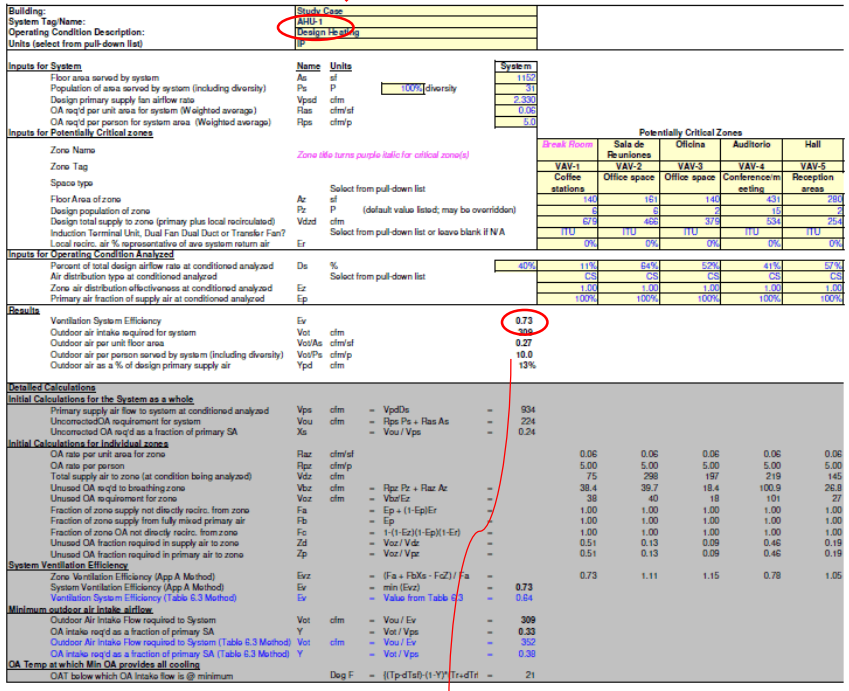
Design Coolig

Design Heating



Building:		Study Case								
System Tag/Name:		AHU-1								
Operating Condition Description:		Design Cooling								
Units (select from pull-down list)		IP								
Inputs for System	Name	Units				System				
Floor area served by system	As	sf				1152				
Population of area served by system (including diversity)	Ps	P	100%	diversity		31				
Design primary supply fan airflow rate	Vpsd	cfm				2,330				
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf				0.06				
OA req'd per person for system area (Weighted average)	Rps	cfm/p				5.0				
Inputs for Potentially Critical zones							Potentially Critical Zones			
Zone Name							Break Room	Sala de Reuniones	Oficina	Auditorio	Hall
Zone Tag		Zone title turns purple italic for critical zone(s)					VAV-1	VAV-2	VAV-3	VAV-4	VAV-5
Space type		Select from pull-down list					Coffee stations	Office space	Office space	Conference/meeting	Reception areas
Floor Area of zone	Az	sf					140	161	140	431	280
Design population of zone	Pz	P	(default value listed; may be overridden)				6	6	2	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm					679	466	379	534	254
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A					ITU	ITU	ITU	ITU	ITU
Local recirc. air % representative of ave system return air	Er						0%	0%	0%	0%	0%
Inputs for Operating Condition Analyzed											
Percent of total design airflow rate at conditioned analyzed	Ds	%				53%	22%	64%	58%	75%	68%
Air distribution type at conditioned analyzed		Select from pull-down list					CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez						1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep						100%	100%	100%	100%	100%
Results											
Ventilation System Efficiency	Ev					0.92					
Outdoor air intake required for system	Vot	cfm				242					
Outdoor air per unit floor area	Vot/As	cfm/sf				0.21					
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p				7.8					
Outdoor air as a % of design primary supply air	Ypd	cfm				10%					
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	1236					
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	224					
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.18					
Initial Calculations for individual zones											
OA rate per unit area for zone	Raz	cfm/sf					0.06	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p					5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm					149	298	220	401	168
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=		38.4	39.7	18.4	100.9	26.8
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=		38	40	18	101	27
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=		1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=		0.26	0.13	0.08	0.25	0.16
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=		0.26	0.13	0.08	0.25	0.16
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=		0.92	1.05	1.10	0.93	1.02
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.92					
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.89					
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	242					
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.20					
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	251					
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.20					
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	=	((Tp-dTsf)-(1-Y)*(Tr+dTrl	=	-15					





Building:		Study Case								
System Tag/Name:		AHU-1								
Operating Condition Description:		Design Heating								
Units (select from pull-down list)		IP								
Inputs for System	Name	Units				System				
Floor area served by system	As	sf				1152				
Population of area served by system (including diversity)	Ps	P	100%	diversity		31				
Design primary supply fan airflow rate	Vpsd	cfm				2,330				
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf				0.06				
OA req'd per person for system area (Weighted average)	Rps	cfm/p				5.0				
Inputs for Potentially Critical zones							Potentially Critical Zones			
Zone Name							Break Room	Sala de Reuniones	Oficina	Auditorio	Hall
Zone Tag		Zone title turns purple italic for critical zone(s)					VAV-1	VAV-2	VAV-3	VAV-4	VAV-5
Space type		Select from pull-down list					Coffee stations	Office space	Office space	Conference/meeting	Reception areas
Floor Area of zone	Az	sf					140	161	140	431	280
Design population of zone	Pz	P	(default value listed; may be overridden)				6	6	2	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm					679	466	379	534	254
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A					ITU	ITU	ITU	ITU	ITU
Local recirc. air % representative of ave system return air	Er						0%	0%	0%	0%	0%
Inputs for Operating Condition Analyzed											
Percent of total design airflow rate at conditioned analyzed	Ds	%				40%	11%	64%	52%	41%	57%
Air distribution type at conditioned analyzed		Select from pull-down list					CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez						1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep						100%	100%	100%	100%	100%
Results											
Ventilation System Efficiency	Ev					0.73					
Outdoor air intake required for system	Vot	cfm				309					
Outdoor air per unit floor area	Vot/As	cfm/sf				0.27					
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p				10.0					
Outdoor air as a % of design primary supply air	Ypd	cfm				13%					
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	934					
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	224					
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.24					
Initial Calculations for individual zones											
OA rate per unit area for zone	Raz	cfm/sf					0.06	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p					5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm					75	298	197	219	145
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=		38.4	39.7	18.4	100.9	26.8
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=		38	40	18	101	27
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=		1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=		0.51	0.13	0.09	0.46	0.19
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=		0.51	0.13	0.09	0.46	0.19
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=		0.73	1.11	1.15	0.78	1.05
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.73					
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.64					
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	309					
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.33					
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	352					
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.38					
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	=	((Tp-dTsf)-(1-Y)*(Tr+dTrl	=	21					

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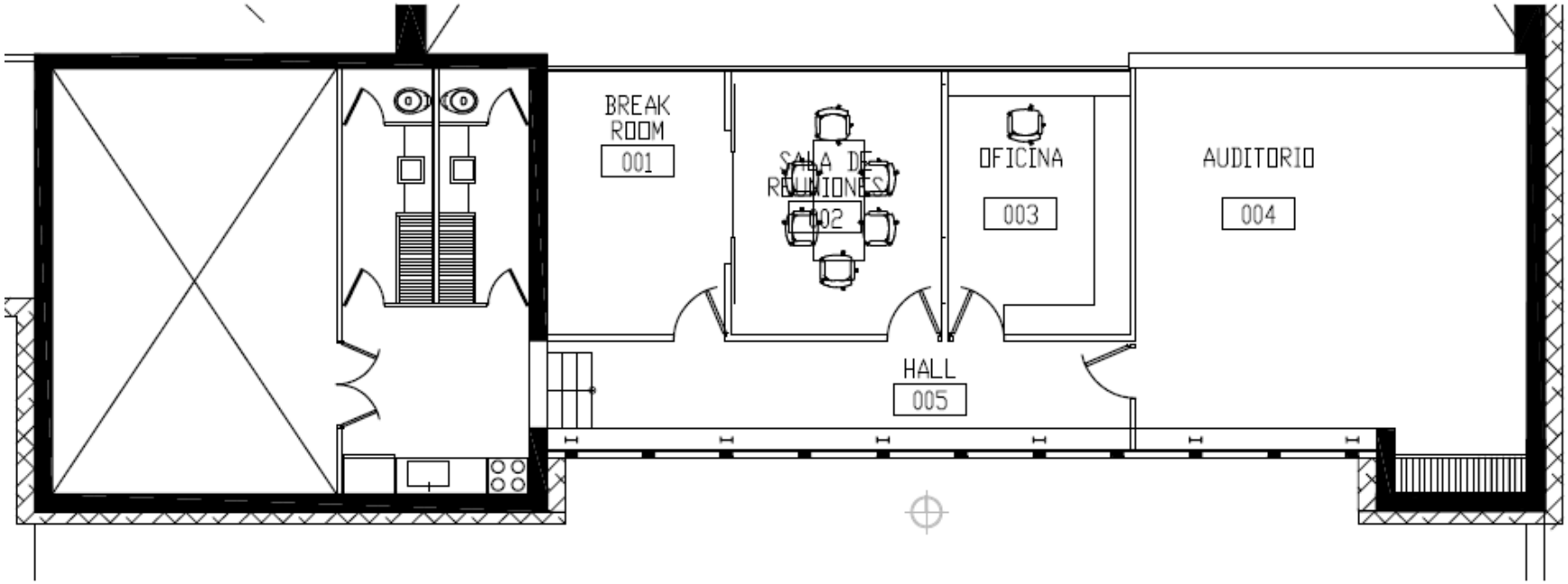

VRP – Sistemas de Zonas Múltiples

CON EL MAYOR Zp DETRMINAMOS EL MENOR Ev DE TABLA 6-3

TABLE 6-3 System Ventilation Efficiency

Max (Z_p)	E_v
≤0.15	1.0
≤0.25	0.9
≤0.35	0.8
≤0.45	0.7
≤0.55	0.6
>0.55	Use Appendix A

1. "Max (Z_{pz})" refers to the largest value of Z_{pz}, calculated using Equation 6-5, among all the *ventilation zones* served by the system.
2. For values of Max (Z_{pz}) between 0.15 and 0.55, the corresponding value of E_v may be determined by interpolating the values in the table.
3. The values of E_v in this table are based on a 0.15 average outdoor air fraction for the system (i.e., the ratio of the uncorrected outdoor air intake (V_{ou}) to the total zone primary airflow for all the zones served by the air handler). For systems with higher values of the average outdoor air fraction, this table may result in unrealistically low values of E_v and the use of Appendix A may yield more practical results.

VRP – Sistemas de Zonas Múltiples

GROUND FLOOR

Standard Case - ASHRAE Std 62.1-2007 Ventilation Rate Procedure

Zone Identification					Vbz - Table 6-1				Design Cooling					Design Heating				
Zone	System Serving	Occupancy Category	Area (sf)	Design Airflow Vpsd (cfm)	People Outdoor Air Rate (cfm.person)	Area Outdoor Air Rate (cfm/sf)	Actual Occupancy Pz (Person)	Breathing Zone Outdoor Air Flow Vbz/(cfm)	Table 6-2 Zone Air Distribution Effectiveness (Ez)	Zone Otudoor Airflow Voz = Vbz/Ez (cfm)	Zone Primary Air Flow Vpz (cfm)	Ds Vpz/Vpsd (%)	Outdoor Aire Fraction Zp = Voz/Vpz	Table 6-2 Zone Air Distribution Effectiveness (Ez)	Zone Otudoor Airflow Voz (cfm)	Zone Primary Air Flow Vpz (cfm)	Ds Vpz/Vpsd (%)	Outdoor Aire Fraction Zp=Voz/Vpz
BREAK ROOM	#1	Coffee Station	140	697	5	0,06	6	38	1	38	150	22	0,26	0,8	48	98	14	0,49
REUNIONES	#1	Office Space	161	466	5	0,06	6	40	1	40	299	64	0,13	0,8	50	299	64	0,17
OFICINA	#1	Office Space	140	379	5	0,06	2	18	1	18	218	58	0,08	0,8	23	195	51	0,12
Auditorio	#1	Conferenc e/meeting	431	534	5	0,06	15	101	1	101	401	75	0,25	0,8	126	270	51	0,47
HALL	#1	Reception Areas	280	254	5	0,06	2	27	1	27	167	66	0,16	0,8	33	248	98	0,14

Max Zp = 0,49 De Tabla 6- 0,66

D = Pz / Σall zones Pz 1

Vou = D Σall zones (Rp x Pz) + Σall zones (Ra x Az) = 224 cfm

Vot = Vou / Ez = 339 cfm

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VRP – Sistemas de Zonas Múltiples

Zone Identification					Vbz - Table 6-1				
Zone	System Serving	Occupancy Categoery	Area (sf)	Design Airflow Vpsd (cfm)	People Outdoor Air Rate (cfm.person)	Area Outdoor Air Rate (cfm/sf)	Actual Occupancy Pz (Person)	Breathing Zone Outdoor Air Flow Vbz/(cfm)	
BREAK ROOM	#1	Coffee Station	140	697	5	0,06	6	38	
REUNIONES	#1	Office Space	161	466	5	0,06	6	40	
OFICINA	#1	Office Space	140	379	5	0,06	2	18	
Auditorio	#1	Conferenc e/meeting	431	534	5	0,06	15	101	
HALL	#1	Reception Areas	280	254	5	0,06	2	27	

VRP – Sistemas de Zonas Múltiples

GROUND FLOOR

Std 62.1-2007 Ventilation Rate Procedure

	Design Cooling					Design Heating				
	Table 6-2 Zone Air Distribution Effectiveness (Ez)	Zone Otudoor Airflow Voz = Vbz/Ez (cfm)	Zone Primary Air Flow Vpz (cfm)	Da Vpz/Vpsd (%)	Outdoor Aire Fraction Zp = Voz/Vpz	Table 6-2 Zone Air Distribution Effectiveness (Ez)	Zone Otudoor Airflow Voz (cfm)	Zone Primary Air Flow Vpz (cfm)	Da Vpz/Vpsd (%)	Outdoor Aire Fraction Zp=Voz/Vpz
	1	38	150	22	0,26	0,8	48	98	14	0,49
	1	40	299	64	0,13	0,8	50	299	64	0,17
	1	18	218	38	0,08	0,8	23	195	31	0,12
	1	101	401	75	0,25	0,8	126	270	51	0,47
	1	27	167	66	0,16	0,8	33	248	98	0,14

VRP – Sistemas de Zonas Múltiples

Max Zp =	0,49	De Tabla 6-	0,66
D = Ps / Σall zones Pz	1		
Vou = D Σall zones (Rp x Pz) + Σall zones (Rs x Az) =		224	cfm
Vot = Vou / Ez =	339	cfm	

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VRP – Sistemas de Zonas Múltiples

Para Zp = 0,49, Ev = 0,66

TABLE 6-3 System Ventilation Efficiency

Max (Z_p)	E_v
≤0.15	1.0
≤0.25	0.9
≤0.35	0.8
≤0.45	0.7
≤0.55	0.6
>0.55	Use Appendix A

1. "Max (Z_{pz})" refers to the largest value of Z_{pz}, calculated using Equation 6-5, among all the *ventilation zones* served by the system.
2. For values of Max (Z_{pz}) between 0.15 and 0.55, the corresponding value of E_v may be determined by interpolating the values in the table.
3. The values of E_v in this table are based on a 0.15 average outdoor air fraction for the system (i.e., the ratio of the uncorrected outdoor air intake (V_{ou}) to the total zone primary airflow for all the zones served by the air handler). For systems with higher values of the average outdoor air fraction, this table may result in unrealistically low values of E_v and the use of Appendix A may yield more practical results.

VRP – Sistemas de Zonas Múltiples

Building:			Study Case							
System Tag/Name:			AHU-1							
Operating Condition Description:			Design Heating							
Units (select from pull-down list)			IP							
Inputs for System	**Name**	**Units**			**System**					
Floor area served by system	As	sf			1152					
Population of area served by system (including diversity)	Ps	P	100% diversity		31					
Design primary supply fan airflow rate	Vpsd	cfm			2,330					
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf			0.06					
OA req'd per person for system area (Weighted average)	Rps	cfm/p			5.0					
Inputs for Potentially Critical zones						**Potentially Critical Zones**				
Zone Name			*Zone title turns purple italic for critical zone(s)*			*Break Room*	Sala de Reuniones	Oficina	Auditorio	Hall
Zone Tag						VAV-1	VAV-2	VAV-3	VAV-4	VAV-5
Space type			Select from pull-down list			Coffee stations	Office space	Office space	Conference/meeting	Reception areas
Floor Area of zone	Az	sf				140	161	140	431	280
Design population of zone	Pz	P	(default value listed; may be overridden)			6	6	2	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm				679	466	379	534	254
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?			Select from pull-down list or leave blank if N/A			ITU	ITU	ITU	ITU	ITU
Local recirc. air % representative of ave system return air	Er					0%	0%	0%	0%	0%
Inputs for Operating Condition Analyzed										
Percent of total design airflow rate at conditioned analyzed	Ds	%			40%	11%	64%	52%	41%	57%
Air distribution type at conditioned analyzed			Select from pull-down list			CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez					1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					100%	100%	100%	100%	100%
Results										
Ventilation System Efficiency	Ev				0.73					
Outdoor air intake required for system	Vot	cfm			309					
Outdoor air per unit floor area	Vot/As	cfm/sf			0.27					
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p			10.0					
Outdoor air as a % of design primary supply air	Ypd	cfm			13%					
Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	=	934					
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As	=	224					
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	=	0.24					
Initial Calculations for Individual zones										
OA rate per unit area for zone	Raz	cfm/sf				0.06	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p				5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				75	298	197	219	145
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	=		38.4	39.7	18.4	100.9	26.8
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	=		38	40	18	101	27
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep	=		1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	=		1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz	=		0.51	0.13	0.09	0.46	0.19
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	=		0.51	0.13	0.09	0.46	0.19
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa	=		0.73	1.11	1.15	0.78	1.05
System Ventilation Efficiency (App A Method)	Ev		= min (Evz)	=	0.73					
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3	=	0.64					
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	=	309					
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	=	0.33					
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	=	352					
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	=	0.38					
OA Temp at which Min OA provides all cooling										
OAT below which OA intake flow is @ minimum		Deg F	= ((Tp-dTsf)-(1-Y)*(Tr+dTf	=	21					

Study Case
AHU-1
Design Heating
IP

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Inputs for System	Name	Units		System
Floor area served by system	As	sf		1152
Population of area served by system (including diversity)	Ps	P	100% diversity	31
Design primary supply fan airflow rate	Vpsd	cfm		2,330
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf		0.06
OA req'd per person for system area (Weighted average)	Rps	cfm/p		5.0

Inputs for Potentially Critical zones				Potentially Critical Zones				
Zone Name		*Zone title turns purple italic for critical zone(s)*		*Break Room*	Sala de Reuniones	Oficina	Auditorio	Hall
Zone Tag				VAV-1	VAV-2	VAV-3	VAV-4	VAV-5
Space type		Select from pull-down list		Coffee stations	Office space	Office space	Conference/meeting	Reception areas
Floor Area of zone	Az	sf		140	161	140	431	280
Design population of zone	Pz	P	(default value listed; may be overridden)	6	6	2	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm		679	466	379	534	254
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A		ITU	ITU	ITU	ITU	ITU
Local recirc. air % representative of ave system return air	Er			0%	0%	0%	0%	0%
Inputs for Operating Condition Analyzed								
Percent of total design airflow rate at conditioned analyzed	Ds	%	40%	11%	64%	52%	41%	57%
Air distribution type at conditioned analyzed		Select from pull-down list		CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez			1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep			100%	100%	100%	100%	100%

Results			
Ventilation System Efficiency	Ev		0.73
Outdoor air intake required for system	Vot	cfm	309
Outdoor air per unit floor area	Vot/As	cfm/sf	0.27
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	10.0
Outdoor air as a % of design primary supply air	Ypd	cfm	13%

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Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	934
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	224
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.24
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf				
OA rate per person	Rpz	cfm/p				
Total supply air to zone (at condition being analyzed)	Vdz	cfm				
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.73
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.64
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	309
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.33
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	352
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.38
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum		Deg F	=	(Tp-dTsf)-(1-Y)*(Tr+dTr	=	21

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Study Case							
Planilla Manual - Tabla 6-3				Apéndice A - 62MZCacl			
Zp Máximo	Ev Mínimo	Vou (cfm)	Vot (cfm)	Zp Máximo	Ev Mínimo	Vou (cfm)	Vot (cfm)
0.49	0.66	224	339	0.51	0.73	224	309

Requisitos Constructivos, Construcción/Puesta en Marcha

Sección 7

7.1 – Fase de Construcción.

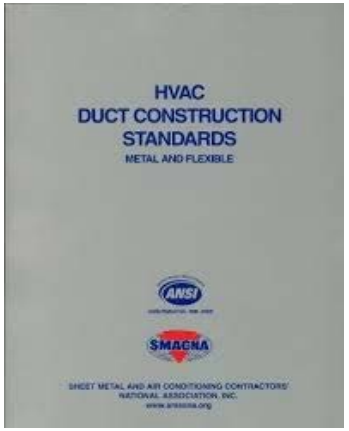
- Las manejadoras no deben funcionar sin filtros.
- Protejer los materiales de Construcción.
- Protejer las áreas ocupadas.
- Limitar la propagación de partículas y contaminante a los espacios ocupados.

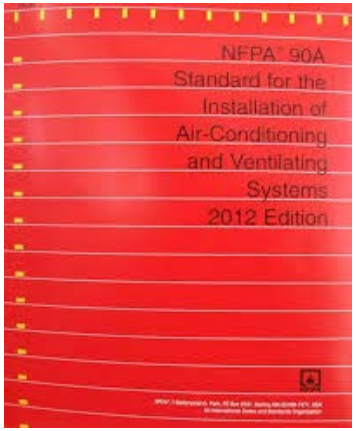
Requisitos Constructivos, Construcción/Puesta en Marcha

Sección 7

7.1 – Fase de Construcción, cont.

- El montaje de los conductos debe estar de acuerdo con SMACNA y NFPA, que prescriben sobre las instalaciones HVAC.





Requisitos Constructivos, Construcción/Puesta en Marcha
Sección 7

7.2 – Puesta en Marcha de los Sistemas.

- Define las pruebas e inspección sobre la limpieza, operación y balanceo de los Sistemas HVAC.

- Emitir documentos que incluyan reportes de balance de caudales, planos conforme a obra, y criterios de diseño e hipótesis que deberán ser presentados al Propietario.

Requisitos de Operación – Operación y Mantenimeinto – Sección 8

8.2 Manual de Operación y Manteimiento

- Desarrollar un manual de operación y mantenimiento del edificio (BOM) que deberá incluir una programación de mantenimeinto con frecuencias de ejecución de cada tarea.

- El BOM deberá ser entregado al Propietario del Edificio.

Requisitos de Operación – Operación y Mantenimeinto – Sección 8

8.3 – Operación de los Sistemas de Ventilación.

- Los sistemas deberán funcionar de acuerdo con el BOM y la Sección 6 cuando los espacios estén ocupados.

8.4 – Mantenimiento de los Sistemas de Ventilación.

- El mantenimiento se llevará a cabo de acuerdo al BOM o como se indica en la Sección 8.

ASHRAE 62.1

- El Standard 62.1 se encuentra en permanente revision y actualización.
  - Todos pueden proponer cambios al Standard.
  - En la sección ASHRAE Standards Action se pueden encontrar las modificaciones propuestas.
- **Los Miembros de ASHRAE** puede ser Voluntarios en la revision del Standard y contribuir a sus actualizaciones.

https://www.ashrae.org/communities/committees/standards-committees

ASHRAE 62.1 - Recursos

- Manual del Usuario del 62.1-2013/2019.
- Cursos ALI Short Course and Professional Development.
- Cursos e-Learning.
- Guía de IAQ Design.
- Next publication of ASHRAE 62.1-2022.

ASHRAE 62.1

Muchas Gracias!!!

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