

NOISE RED FLAG TABLES

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MINISTRY OF ENVIRONMENT

"DRAFT"
FOR DISCUSSION PURPOSES
ONLY

INTRODUCTION

This Publication provides a simplified screening procedure, designed to determine if a detailed noise impact assessment is required for equipment/facilities subject to approval under the provisions of Section 9 of the Environmental Protection Act. It has been developed to streamline the review and approval process.

The Publication consists of a set of tables which set out the minimum setback distance between equipment/facility and noise sensitive points of reception required to ensure compliance with sound level limits set in the Ministry of Environment & Energy Noise Criteria. Twelve distinct groups of typical industrial noise sources are represented in the tables in terms of their power rating or a combination of other operating parameters which correlate with noise emissions.

If any point of reception is separated from the proposed equipment/facility by a distance greater than the minimum setback distance shown in the tables, for a specific type of equipment and time of equipment operation, a detailed noise impact assessment is not required.

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GENERAL ASSUMPTIONS FOR ALL SOURCES IN RED FLAG TABLES

1. It is assumed the type of ground between the receiver and the source is flat and acoustically porous, (ie. grass) and attenuation due to the ground is based on international standard ISO 9613-2, "Acoustics - Attenuation of sound during propagation outdoors, Part 2: General method of calculation".
2. Atmospheric attenuation is based on data for "Standard Day" in Table 6-1 of the BBN report; "Noise Control for Buildings and Manufacturing Plants", Bolt Beranek and Newman Inc.
3. It is also assumed sources are not enclosed, and have not been treated with any type of sound absorbent material with exception of diesel generators. It is assumed the generator is enclosed in a room composed of concrete block walls, concrete floor and a drywall ceiling. It is further assumed that the area of the intake opening is 1.5 m².
4. Noise sources are assumed to be 3m (fans, assumed to be 5 m) above ground level. The receiver is assumed to be 1.5 m above ground level.

RESULTS

The first column is applicable to daytime operations and the second column to night-time operations.

For asphalt plant burners, the first column is applicable to a receptor location close to an arterial road, the second to day-time, the third to night-time operations.

REFERENCES

- Air Compressors - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Asphalt Burners - Environmental Noise In And Around Hot Mix Asphalt Plants, Napa IS-63
- De-Barking Drum - Noise Control Solutions for Paper Products Industry, Richard K. Miller, Wayne V. Montone & Mark d Oviat
- Boilers - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc. 1981
- Chillers - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Cooling Towers - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981

- Diesel Engines - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Fans - 1987 ASHRAE HVAC Handbook, Chapter 52
- Flares - Concord Environmental Noise Study, Straitz 1977, Swithenbank, 1972
- Motors - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Pumps - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Steam Turbines - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981
- Steam Valves - Noise Control for Buildings and Manufacturing Plants, Bolt Beranek and Newman Inc., 1981

AIR COMPRESSORS, 1 - 75 HP

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1 - 2	70	110
3 - 9	92	144
10 - 75	120	190

MINIMUM SETBACK REQUIREMENTS (IN METRES) FOR ASPHALT PLANT BURNERS
TO ENSURE COMPLIANCE WITH MOEE NOISE GUIDELINES

NOISE CRITERIA ONE HOUR Leq		55 dBA	50 dBA	45 dBA
Burner Type	Burner Rating (MKJ/HR)	Arterial Road Nearby (0700-1900)	Day Time Operation No Nearby Traffic (0700-1900)	Night Time Operation No Nearby Traffic (1900-0700)
GAS FIRED	5	40	65	105
	10	95	155	270
	15	160	275	480
	20	240	415	720
	25	330	575	990
	30	430	745	> 1000
	35	535	925	> 1000
	40	650	> 1000	> 1000
	45	765	> 1000	> 1000
	> 50	> 1000	> 1000	> 1000
OIL FIRED	5	35	55	85
	10	80	130	220
	15	135	225	390
	20	195	340	585
	25	270	465	800
	30	345	600	> 1000
	35	430	745	> 1000
	40	520	900	> 1000
	45	615	> 1000	> 1000
	50	715	> 1000	> 1000
	55	815	> 1000	> 1000
60	920	> 1000	> 1000	

NOISE CRITERIA ONE HOUR Leq		55 dBA	50 dBA	45 dBA
Burner Type	Burner Rating (MKJ/HR) ^{**}	Arterial Road Nearby (0700-1900)	Day Time Operation No Nearby Traffic (0700-1900)	Night Time Operation No Nearby Traffic (1900-0700)
	> 65	> 1000	> 1000	> 1000
LOW NOISE (WITH HUSH KIT)	5	10	20	30
	10	30	40	60
	15	40	60	90
	20	50	80	130
	25	60	100	170
	30	80	130	210
	35	90	160	260
	40	110	190	320
	45	130	220	370
	50	150	250	430
	55	170	290	500
	60	190	320	560
	65	210	360	630
	70	230	400	700
	75	250	440	770
	80	280	480	850
	85	300	530	930
90	330	570	1000	
95	350	620	> 1000	
100	380	660	> 1000	

* 1 MBTU/HR = 1.1 MKJ/HR

DEBARKING DRUM

<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>(m)</i>	<i>(m)</i>
225	380

BOILERS, 50 - 2000 BHP

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>BHP</i>	<i>(m)</i>	<i>(m)</i>
50-300	65	106
301-2000	87	144

1 BHP = 33,500 BTU/HR
 BHP - boiler horse power

CHILLERS

INPUT DATA: CC = Cooling Capacity (tons)

PACKAGED CHILLERS WITH RECIPROCATING COMPRESSORS

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>CC</i>	<i>(m)</i>	<i>(m)</i>
10-30	59	93
31-80	77	125
81-200	103	167

note: a ton of cooling capacity is defined as the amount of heat removal required to produce one ton of ice per 24hr period or 12,000 BTU per hour)

PACKAGED CHILLERS WITH ROTARY-SCREW COMPRESSORS
 100 - 300 TONS, AT OR NEAR 3600 RPM

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>CC</i>	<i>(m)</i>	<i>(m)</i>
100-300	88	144

PACKAGED CHILLERS WITH CENTRIFUGAL COMPRESSORS
100 - 1000 TONS, internally geared, hermetically sealed

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>CC</i>	<i>(m)</i>	<i>(m)</i>
101	85	135
150	100	155
200	110	175
250	120	190
300	125	200
350	135	210
400	140	220
450	145	230
500	150	240
550	155	250
600	160	255
650	165	265
700	170	270
750	175	280
800	180	285
850	185	290
900	190	295
950	190	305
1000	195	310

note:

systems are internally geared, hermetically sealed centrifugal compressors

PACKAGED CHILLERS WITH ROTARY CENTRIFUGAL COMPRESSORS,
100 - 1000 TONS, direct driven & hermetically sealed

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>CC</i>	<i>(m)</i>	<i>(m)</i>
101	50	75
150	60	95
200	70	110
250	80	125
300	85	135
350	95	150
400	100	160
450	110	175
500	115	185
550	120	195
600	130	205
650	135	215
700	140	225
750	145	230
800	150	240
850	155	250
900	160	260
950	165	265
1000	170	275

**PACKAGED CHILLERS WITH CENTRIFUGAL COMPRESSORS
HERMETICALLY SEALED & RATED ABOVE 1000 TONS**

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>CC</i>	<i>(m)</i>	<i>(m)</i>
1001	245	380
1250	255	400
1500	270	415
1750	275	430
2000	285	440
2250	295	455
2500	300	465
2750	310	475
3000	315	480
3250	320	490
3500	325	500
3750	330	505
4000	335	515
4250	340	520
4500	345	525
4750	350	530
5000	355	540
5250	355	545
5500	360	550
5750	365	555
6000	370	560
6250	370	565

6500	375	570
6750	380	575
7000	380	575

COOLING TOWER NOISE LEVELS

HP: 1 to 100

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1	42	64
5	68	110
10	86	140
15	98	160
20	108	180
25	116	190
30	124	205
35	130	215
40	136	225
45	142	235
50	148	245
55	155	250
60	160	260
65	165	265
70	165	275
75	170	280
80	175	285
85	180	295
90	180	300

95	185	305
100	190	310

COOLING TOWER NOISE LEVELS
HP: 101 - 1000

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
101	190	310
150	225	365
200	255	415
250	280	455
300	305	490
350	325	525
400	340	550
450	360	580
500	375	605
550	390	630
600	405	650
650	420	670
700	435	695
750	445	710
800	455	730
850	470	750
900	480	765
950	490	780
1000	500	800

DIESEL ENGINE INTAKE AND CASING NOISE
RPM > 1,500, HP: 51 - 1300

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
51	90	140
100	115	185
150	135	215
200	150	245
250	165	265
300	180	285
350	190	305
400	200	320
450	210	335
500	220	350
550	225	360
600	235	375
650	245	385
700	250	395
750	255	410
800	265	420
850	270	430
900	275	435
950	285	445
1000	290	455
1050	295	465
1100	300	470
1150	305	480
1200	310	485
1250	315	495
1300	320	500

DIESEL ENGINE INTAKE AND CASING NOISE
RPM > 1,500 , HP: 1350 - 1500

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1350	325	n/a
1400	330	n/a
1450	335	n/a
1500	340	n/a

**DIESEL ENGINE INTAKE AND CASING NOISE:
RPM BETWEEN 600 & 1500, HP: 50 - 1300**

<i>HP</i>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	<i>(m)</i>	<i>(m)</i>
51	80	135
100	105	175
150	125	205
200	140	225
250	155	250
300	165	265
350	175	285
400	185	300
450	195	315
500	205	325
550	210	340
600	220	350
650	225	365
700	235	375
750	240	385
800	245	395
850	255	405
900	260	410
950	265	420
1000	270	430
1050	275	435
1100	280	445
1150	285	455
1200	290	460
1250	295	470
1300	300	475

DIESEL ENGINE INTAKE AND CASING NOISE
RPM BETWEEN 600 & 1500, HP: 1350 - 1500

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1350	305	480
1400	310	490
1450	315	495
1500	320	500

**DIESEL ENGINE INTAKE AND CASING NOISE:
RPM < 600 , HP: 51 - 1500**

<i>HP</i>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	<i>(m)</i>	<i>(m)</i>
51	75	120
100	95	155
150	110	185
200	125	205
250	140	225
300	150	245
350	160	260
400	165	275
450	175	290
500	185	300
550	190	315
600	200	325
650	205	335
700	210	345
750	220	355
800	225	365
850	230	375
900	235	380
950	240	390
1000	245	400
1050	250	405
1100	255	415
1150	260	420
1200	265	430
1250	270	435
1300	275	445
1350	280	450
1400	285	455
1450	285	465
1500	290	470

DIESEL ENGINE INTAKE AND CASING NOISE:

RPM < 600, HP: 1501 - 2800

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1501	290	470
1550	295	475
1600	300	485
1650	305	490
1750	310	500
1800	315	505
1850	320	510
1900	320	515
1950	325	520
2000	330	530
2050	330	535
2100	335	540
2150	340	545
2200	340	550
2250	345	555
2300	350	560
2350	350	565
2400	355	565
2450	355	570
2500	360	575
2550	365	580
2600	365	585
2650	370	590
2700	370	595
2750	375	600
2800	375	605

DIESEL ENGINE INTAKE AND CASING NOISE
RPM < 600, HP: 2850 - 4000

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
2850	380	605
2900	380	610
2950	385	615
3000	390	320
3050	390	625
3100	395	625
3150	395	630
3200	400	635
3250	400	640
3300	405	645
3350	405	645
3400	410	650
3450	410	655
3500	415	660
3550	415	660
3600	420	665
3650	420	670
3700	425	670
3750	425	675
3800	425	680
3850	430	685
3900	430	685
3950	435	690
4000	435	695

DIESEL ENGINE INTAKE AND CASING NOISE:
RPM < 600 , HP: 1501 - 2800

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
1501	290	470
1550	295	475
1600	300	485
1650	305	490
1750	310	500
1800	315	505
1850	320	510
1900	320	515
1950	325	520
2000	330	530
2050	330	535
2100	335	540
2150	340	545
2200	340	550
2250	345	555
2300	350	560
2350	350	565
2400	355	565
2450	355	570
2500	360	575
2550	365	580
2600	365	585
2650	370	590
2700	370	595
2750	375	600
2800	375	605

DIESEL ENGINE INTAKE AND CASING NOISE
RPM < 600, HP: 2850 - 4000

<i>HP</i>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA</i>
	<i>(m)</i>	<i>(m)</i>
2850	380	605
2900	380	610
2950	385	615
3000	390	620
3050	390	625
3100	395	625
3150	395	630
3200	400	635
3250	400	640
3300	405	645
3350	405	645
3400	410	650
3450	410	655
3500	415	660
3550	415	660
3600	420	665
3650	420	670
3700	425	670
3750	425	675
3800	425	680
3850	430	685
3900	430	685
3950	435	690
4000	435	695

DIESEL ENGINE EXHAUST, WITH RESIDENTIAL GRADE MUFFLER

HP: 1 - 2000

	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Hp	(m)	(m)
1	28	42
50	125	210
100	170	290
150	205	350
200	235	400
250	260	440
300	285	480
350	310	520
400	320	550
450	340	580
500	360	620
550	380	640
600	390	660
650	410	700
700	420	720
750	430	740
800	450	760
850	460	780
900	470	800
950	480	820
1000	490	840
1050	510	860
1100	520	880
1150	530	900
1200	540	920
1250	550	920

**DIESEL ENGINE EXHAUST, WITH RESIDENTIAL
GRADE MUFFLER
HP: 1 - 2000**

Hp	Minimum Set-Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set-Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
1300	560	940
1350	570	960
1400	580	980
1450	590	1000
1500	590	1000
1550	600	1020
1600	620	1040
1650	620	1060
1700	640	1060
1750	640	1080
1800	660	1100
1850	660	1100
1900	660	1120
1950	680	1140
2000	680	1140

DIESEL ENGINE EXHAUST NOISE WITH RESIDENTIAL MUFFLER

HP: 2001 - 4000

Hp	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
2001	680	1140
2050	700	1160
2100	700	1180
2150	700	1180
2200	720	1200
2250	720	1200
2300	720	1220
2350	740	1240
2400	740	1240
2450	740	1260
2500	760	1260
2550	760	1280
2600	760	1280
2650	780	1300
2700	780	1300
2750	780	1320
2800	800	1340
2850	800	1340
2900	800	1360
2950	820	1360
3000	820	1380
3050	820	1380
3100	840	1400
3150	840	1400
3200	840	1420
3250	860	1420

**DIESEL ENGINE EXHAUST NOISE WITH
RESIDENTIAL MUFFLER
HP: 2001 - 4000**

Hp	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
3300	860	1440
3350	860	1440
3400	860	1440
3450	880	1460
3500	880	1460
3550	880	1480
3600	900	1480
3650	900	1500
3700	900	1500
3750	900	1520
3800	920	1520
3850	920	n/a
3900	920	n/a
3950	920	n/a
4000	940	n/a

**DIESEL ENGINE EXHAUST NOISE WITH
RESIDENTIAL MUFFLER & CASING NOISE
RPM > 1500 ; HP: 1 - 2000**

Hp	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
1	75	115
50	305	460
100	390	590
150	450	680
200	500	750
250	540	810
300	580	860
350	610	910
400	640	950
450	670	990
500	690	1020
550	710	1060
600	740	1090
650	760	1120
700	780	1150
750	790	1170
800	810	1200
850	830	1230
900	850	1250
950	860	1270
1000	880	1290
1050	890	1320
1100	910	1340
1150	920	1360
1200	930	1380
1250	950	1400

**DIESEL ENGINE EXHAUST NOISE WITH
RESIDENTIAL MUFFLER & CASING NOISE
RPM > 1500 ; HP: 1 - 2000**

Hp	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
1300	960	1410
1350	970	1430
1400	980	1450
1450	990	1470
1500	1010	1490
1550	1020	1500
1600	1030	1520
1650	1040	1530
1700	1050	1550
1750	1060	1570
1800	1070	1580
1850	1080	1600
1900	1090	1610
1950	1100	1620
2000	1110	1640

FANS

CENTRIFUGAL FANS

FAN CASE 1:

Centrifugal air foil, backward curved or inclined blade over 36 inches

Q = flow rate (cfm)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
P = pressure (in. of water)		
$Q \cdot P^2$	(m)	(m)
50	2	3
250	4	7
1,250	8	15
6,250	19	33
8,125	21	37
10,563	24	40
13,731	28	43
17,851	32	47
23,206	36	51
30,168	38	56
33,184	40	58
36,503	41	60
40,153	42	65
44,168	43	65
48,585	45	70
53,444	46	70
58,788	47	75
64,667	49	75
71,134	51	80
78,247	52	80
86,072	54	85
94,679	56	90
104,147	58	90
114,561	60	95
126,017	65	100

FAN CASE 1:
Centrifugal air foil, backward curved or inclined blade over 36 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
138,619	65	105
152,481	70	105
167,729	70	110
184,502	75	115
202,952	75	120
223,247	80	125
245,572	80	130
270,129	85	135
297,142	90	140
326,857	90	145
359,542	95	150
395,496	100	160
435,046	100	165
478,551	105	170
526,406	110	180
579,046	115	185
636,951	120	195
700,646	125	200
770,711	130	210
847,782	135	220
932,560	140	230
1,025,816	145	240
1,128,398	150	250
1,241,237	155	260
1,365,361	165	270
1,501,897	170	280
1,652,087	180	290

FAN CASE I:-
Centrifugal air foil, backward curved or inclined blade over 36 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q \cdot P^2$	(m)	(m)
1,817,296	185	300
1,999,025	190	320
2,198,928	200	330
2,418,821	210	340
2,660,703	220	360
2,926,773	230	370
3,219,450	240	380
3,541,395	250	400
3,895,535	260	420
4,285,088	270	430
4,713,597	280	450
5,184,957	290	470
5,703,452	300	490
6,273,798	310	520
6,901,177	330	540
7,591,295	340	560
8,350,425	350	580
9,185,467	370	600

FAN CASE 2
Centrifugal air foil, backward curved or inclined blade under 36 inches

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA
	(m)	(m)
50	3	5
250	7	12
1,250	15	27
6,250	33	49
8,125	37	53
10,563	40	58
13,731	43	65
17,851	47	75
23,206	51	80
30,168	56	90
33,184	58	90
36,503	60	95
40,153	65	100
44,168	65	105
48,585	70	105
53,444	70	110
58,788	75	115
64,667	75	120
71,134	80	125
78,247	80	130
86,072	85	135
94,679	90	140
104,147	90	145
114,561	95	155
126,017	100	160
138,619	105	165

FAN CASE 2
Centrifugal air foil, backward curved or inclined blade under 36 inches

$Q =$ flow rate (cfm) $P =$ pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q \cdot P^2$	(m)	(m)
152,481	105	170
167,729	110	180
184,502	115	185
202,952	120	195
223,247	125	200
245,572	130	210
270,129	135	220
297,142	140	230
326,857	145	240
359,542	150	250
395,496	160	260
435,046	165	270
478,551	170	280
526,406	180	290
579,046	185	310
636,951	195	320
700,646	200	330
770,711	210	340
847,782	220	360
932,560	230	370
1,025,816	240	390
1,128,398	250	400
1,241,237	260	420
1,365,361	270	440
1,501,897	280	450
1,652,087	290	470

FAN CASE 2
Centrifugal air foil, backward curved or inclined blade under 36 inches

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q \cdot P^2$	(m)	(m)
1,817,296	300	490
1,999,025	320	520
2,198,928	330	540
2,418,821	340	560
2,660,703	360	580
2,926,773	370	600
3,219,450	390	620
3,541,395	400	640
3,895,535	420	660
4,285,088	430	700
4,713,597	450	720
5,184,957	470	740
5,703,452	490	780
6,273,798	520	800
6,901,177	540	840
7,591,295	560	860
8,350,425	580	900
9,185,467	600	920

FAN CASE 3
Centrifugal forward curved blade all sizes

Q = flow rate (cfm) P = pressure drop (m. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
50	4	7
250	9	15
1,250	19	34
6,250	39	58
8,125	43	65
10,563	47	70
13,731	51	80
17,851	56	90
23,206	65	95
30,168	70	110
33,184	70	110
36,503	75	115
40,153	75	120
44,168	80	125
48,585	85	130
53,444	85	135
58,788	90	140
64,667	90	145
71,134	95	150
78,247	100	160
86,072	105	165
94,679	105	170
104,147	110	180
114,561	115	185
126,017	120	195
138,619	125	200

FAN CASE 3
Centrifugal forward curved blade all sizes

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
152,481	130	210
167,729	135	220
184,502	140	230
202,952	145	240
223,247	150	250
245,572	160	260
270,129	165	270
297,142	170	280
326,857	180	290
359,542	185	300
395,496	195	310
435,046	200	330
478,551	210	340
526,406	220	350
579,046	230	370
636,951	240	380
700,646	250	400
770,711	260	410
847,782	270	430
932,560	280	450
1,025,816	290	460
1,128,398	300	480
1,241,237	310	500
1,365,361	330	520
1,501,897	340	540
1,652,087	350	560
1,817,296	370	580

FAN CASE 3
Centrifugal forward curved blade all sizes

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	Q*P ²	(m)
1,999,025	380	600
2,198,928	400	640
2,418,821	410	660
2,660,703	430	680
2,926,773	440	700
3,219,450	460	740
3,541,395	480	760
3,895,535	500	780
4,285,088	520	820
4,713,597	540	840
5,184,957	560	880
5,703,452	580	920
6,273,798	600	940
6,901,177	640	980
7,591,295	660	1100
8,350,425	680	1100
9,185,467	700	1100

FAN CASE-4
Centrifugal radial, forward curved blade over 40 inches

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
50	7	13
250	16	29
1,250	36	51
6,250	60	95
8,125	70	105
10,563	75	120
13,731	85	130
17,851	90	145
23,206	100	165
30,168	115	185
33,184	120	190
36,503	125	200
40,153	130	210
44,168	135	220
48,585	140	230
53,444	145	240
58,788	150	250
64,667	155	260
71,134	160	270
78,247	170	280
86,072	175	290
94,679	185	300
104,147	190	320
114,561	200	330
126,017	210	340
138,619	220	360

FAN CASE 4
Centrifugal radial, forward curved blade over 40 inches

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
152,481	230	370
167,729	240	390
184,502	250	400
202,952	260	420
223,247	270	440
245,572	280	450
270,129	290	470
297,142	300	490
326,857	320	520
359,542	330	540
395,496	340	560
435,046	360	580
478,551	370	600
526,406	390	620
579,046	400	660
636,951	420	680
700,646	440	700
770,711	450	740
847,782	470	760
932,560	490	800
1,025,816	520	820
1,128,398	540	860
1,241,237	560	880
1,365,361	580	920
1,501,897	600	960
1,652,087	620	980

FAN CASE 4
Centrifugal radial, forward curved blade over 40 inches

Q = flow rate (cfm) P = pressure drop (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	Q*P ²	(m)
1,817,296	660	1100
1,999,025	680	1100
2,198,928	700	1100
2,418,821	740	1200
2,660,703	760	1200
2,926,773	780	1300
3,219,450	820	1300
3,541,395	840	1400
3,895,535	880	1400
4,285,088	920	1400
4,713,597	940	1500
5,184,957	980	1500
5,703,452	1100	1600
6,273,798	1100	1600
6,901,177	1100	n/a
7,591,295	1200	n/a
8,350,425	1200	n/a
9,185,467	1300	n/a

FAN CASE 5
 Pressure Blower; Centrifugal radial, straight blade ; 20 to 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q \cdot P^2$	(m)	(m)
50	15	27
250	34	50
1,250	58	90
1,625	65	100
2,113	75	115
2,746	80	125
3,570	90	140
4,641	100	155
6,034	110	175
7,844	120	195
10,197	135	220
13,256	150	250
17,232	170	280
22,402	190	310
29,123	210	350
37,859	240	390
41,645	250	400
45,810	260	420
50,391	270	440
55,430	280	450
60,973	290	470
67,070	300	490
73,777	320	520
81,155	330	540
89,270	340	560
98,198	360	580

FAN CASE 5
 Pressure Blower; Centrifugal radial, straight blade ; 20 to 40 inches

Q = flow rate (cfm) P = pressure (m. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
108,017	370	600
118,819	390	620
130,701	400	640
143,771	420	680
158,148	430	700
173,963	450	720
191,359	470	760
210,495	490	780
231,545	520	820
254,699	540	840
280,169	560	880
308,186	580	900
339,004	600	940
372,905	620	980
410,195	640	1100
451,215	680	1100
496,336	700	1100
545,970	720	1200
600,567	760	1200
660,624	780	1200
726,686	800	1300
799,355	840	1300
879,290	880	1400
967,219	900	1400
1,063,941	940	1500
1,170,335	980	1500

FAN CASE 5

Pressure Blower: Centrifugal radial, straight blade ; 20 to 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
1,287,369	1000	1600
1,416,106	1100	1600
1,557,716	1100	n/a
1,713,488	1200	n/a
1,884,837	1200	n/a
2,073,320	1200	n/a
2,280,652	1300	n/a
2,508,717	1300	n/a
2,759,589	1400	n/a
3,035,548	1400	n/a
3,339,103	1500	n/a
3,673,013	1500	n/a
4,040,314	1600	n/a
4,444,346	1600	n/a
4,888,780	n/a	n/a
5,377,659	n/a	n/a
5,915,424	n/a	n/a
6,506,967	n/a	n/a
7,157,663	n/a	n/a
7,873,430	n/a	n/a
8,660,773	n/a	n/a
9,526,850	n/a	n/a

FAN CASE 6
 Pressure Blower, Centrifugal radial blade under 20 inches

Q = flow rate (cfm) P = pressure (m. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
50	26	41
250	48	75
1,250	90	145
1,625	100	160
2,113	110	180
2,746	125	200
3,570	135	230
4,641	155	260
6,034	170	290
7,844	190	320
10,197	220	360
13,256	240	400
17,232	270	450
22,402	310	520
29,123	340	580
37,859	390	640
41,645	400	660
45,810	420	680
50,391	440	720
55,430	450	740
60,973	470	780
67,070	490	800
73,777	520	840
81,155	540	880
89,270	560	900
98,198	580	940

FAN CASE 6
 Pressure Blower; Centrifugal radial, blade under 20 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
108,017	620	980
118,819	640	1100
130,701	660	1100
143,771	680	1100
158,148	720	1200
173,963	740	1200
191,359	780	1300
210,495	800	1300
231,545	840	1400
254,699	860	1400
280,169	900	1500
308,186	940	1500
339,004	980	1600
372,905	1100	1600
410,195	1100	n/a
451,215	1100	n/a
496,336	1200	n/a
545,970	1200	n/a
600,567	1300	n/a
660,624	1300	n/a
726,686	1400	n/a
799,355	1400	n/a
879,290	1400	n/a
967,219	1500	n/a
1,063,941	1600	n/a
1,170,335	1600	n/a

FAN CASE 6
 Pressure Blower; Centrifugal radial, blade under 20 inches

Q = flow rate (cfm) P = pressure (m. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
1,287,369	n/a	n/a
1,416,106	n/a	n/a
1,557,716	n/a	n/a
1,713,488	n/a	n/a
1,884,837	n/a	n/a
2,073,320	n/a	n/a
2,280,652	n/a	n/a
2,508,717	n/a	n/a
2,759,589	n/a	n/a
3,035,548	n/a	n/a
3,339,103	n/a	n/a
3,673,013	n/a	n/a
4,040,314	n/a	n/a
4,444,346	n/a	n/a
4,888,780	n/a	n/a
5,377,659	n/a	n/a
5,915,424	n/a	n/a
6,506,967	n/a	n/a
7,157,663	n/a	n/a
7,873,430	n/a	n/a
8,660,773	n/a	n/a
9,526,850	n/a	n/a

VANEAXIAL FANS

FAN CASE 7:
Vaneaxial fan with wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
50	6	11
250	14	25
1,250	31	46
1,625	35	51
2,113	38	55
2,746	41	65
3,570	45	70
4,641	49	75
6,034	53	85
7,844	59	95
10,197	65	105
13,256	75	115
17,232	80	125
22,402	90	140
29,123	100	160
37,859	110	175
41,645	115	185
45,810	120	190
50,391	125	200
55,430	130	210
60,973	135	220
67,070	140	230
73,777	145	240
81,155	150	250

FAN CASE 7:
Vaneaxial fan with wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
89,270	155	260
98,198	160	270
108,017	170	280
118,819	175	290
130,701	185	300
143,771	190	310
158,148	200	320
173,963	210	340
191,359	220	350
210,495	230	370
231,545	240	380
254,699	250	400
280,169	250	410
308,186	270	430
339,004	280	450
372,905	290	460
410,195	300	480
451,215	310	500
496,336	320	520
545,970	340	540
600,567	350	560
660,624	360	580
726,686	380	620
799,355	390	640
879,290	410	660
967,219	430	680

FAN CASE 7:
Vaneaxial fan with wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q \cdot P^2$	(m)	(m)
1,063,941	440	700
1,170,335	460	740
1,287,369	480	760
1,416,106	500	800
1,557,716	520	820
1,713,488	540	860
1,884,837	560	880
2,073,320	580	920
2,280,652	600	940
2,508,717	640	980
2,759,589	660	1100
3,035,548	680	1100
3,339,103	700	1100
3,673,013	740	1200
4,040,314	760	1200
4,444,346	800	1300
4,888,780	820	1300
5,377,659	860	1300
5,915,424	880	1400
6,506,967	920	1400
7,157,663	940	1500
7,873,430	980	1500
8,660,773	1100	1600
9,526,850	1100	1600

FAN CASE 8
Vaneaxial fan with wheel size under 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
Q*p ²		
50	6	11
250	14	25
1,250	31	46
1,625	35	51
2,113	38	55
2,746	41	65
3,570	45	70
4,641	49	75
6,034	53	85
7,844	59	95
10,197	65	105
13,256	75	115
17,232	80	125
22,402	90	140
29,123	100	160
37,859	110	175
41,645	115	185
45,810	120	190
50,391	125	200
55,430	130	210
60,973	135	220
67,070	140	230
73,777	145	240
81,155	150	250
89,270	155	260
98,198	160	270

FAN CASE 8
Vaneaxial fan with wheel size under 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	Q*P ² (m)	(m)
108,017	170	280
118,819	175	290
130,701	185	300
143,771	190	310
158,148	200	320
173,963	210	340
191,359	220	350
210,495	230	370
231,545	240	380
254,699	250	400
280,169	250	410
308,186	270	430
339,004	280	450
372,905	290	460
410,195	300	480
451,215	310	500
496,336	320	520
545,970	340	540
600,567	350	560
660,624	360	580
726,686	380	620
799,355	390	640
879,290	410	660
967,219	430	680
1,063,941	440	700
1,170,335	460	740

FAN CASE 8
Vaneaxial fan with wheel size under 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
$Q^2 \cdot P^2$	(m)	(m)
1,287,369	480	760
1,416,106	500	800
1,557,716	520	820
1,713,488	540	860
1,884,837	560	880
2,073,320	580	920
2,280,652	600	940
2,508,717	640	980
2,759,589	660	1100
3,035,548	680	1100
3,339,103	700	1100
3,673,013	740	1200
4,040,314	760	1200
4,444,346	800	1300
4,888,780	820	1300
5,377,659	860	1300
5,915,424	880	1400
6,506,967	920	1400
7,157,663	940	1500
7,873,430	980	1500
8,660,773	1100	1600
9,526,850	1100	1600

TUBEAXIAL FANS

FAN CASE 9:

Tubeaxial Fan (no straightening vanes) wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
50	9	15
250	19	34
1,250	40	58
1,625	43	65
2,113	47	70
2,746	51	80
3,570	56	90
4,641	65	100
6,034	70	110
7,844	75	120
10,197	85	135
13,256	95	150
17,232	105	170
22,402	115	185
29,123	130	210
37,859	145	240
41,645	150	250
45,810	155	260
50,391	160	270
55,430	170	280
60,973	175	290
67,070	185	300
73,777	190	310
81,155	200	330
89,270	210	340
98,198	220	350

FAN CASE 9:
 Tubeaxial Fan (no straightening vanes) wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
108,017	230	370
118,819	240	380
130,701	250	400
143,771	260	410
158,148	270	430
173,963	280	450
191,359	290	470
210,495	300	480
231,545	310	500
254,699	320	520
280,169	340	540
308,186	350	580
339,004	370	600
372,905	380	620
410,195	400	640
451,215	410	660
496,336	430	680
545,970	450	720
600,567	460	740
660,624	480	780
726,686	500	800
799,355	520	820
879,290	540	860
967,219	560	900
1,063,941	600	920
1,170,335	620	960

FAN CASE 9:
 Tubeaxial Fan (no straightening vanes) wheel size over 40 inches

Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
Q*P ²	(m)	(m)
1,287,369	640	1000
1,416,106	660	1100
1,557,716	680	1100
1,713,488	720	1100
1,884,837	740	1200
2,073,320	760	1200
2,280,652	800	1300
2,508,717	820	1300
2,759,589	860	1400
3,035,548	880	1400
3,339,103	920	1400
3,673,013	960	1500
4,040,314	1000	1500
4,444,346	1100	1600
4,888,780	1100	1600
5,377,659	1100	n/a
5,915,424	1200	n/a
6,506,967	1200	n/a
7,157,663	1300	n/a
7,873,430	1300	n/a
8,660,773	1300	n/a
9,526,850	1400	n/a

FAN CASE 10 Tubaxial (no straightening vanes) wheel size under 40 inches		
Q = flow rate (cm ³)	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria: 45 dBA
P = pressure (m ³ of water)		
Q * P	(m)	(m)
50	15	27
250	34	50
1,250	58	90
1,625	65	100
2,113	75	115
2,746	80	125
3,570	90	140
4,641	100	155
6,034	110	175
7,844	120	195
10,197	135	220
13,256	150	250
17,232	170	280
22,402	190	310
29,123	210	340
37,859	240	380
41,645	250	400
45,810	260	410
50,391	270	430
55,430	280	450
60,973	290	470
67,070	300	480
73,777	310	500
81,155	330	520
89,270	340	540
98,198	350	580

FAN CASE 10 Tubaxial (no straightening vanes) wheel size under 40 inches		
Q = flow rate (cfm) P = pressure (in. of water)	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria 45 dBA
Q * P	(m)	(m)
108,017	370	600
118,819	380	620
130,701	400	640
143,771	410	660
158,148	430	680
173,963	450	720
191,359	460	740
210,495	480	760
231,545	500	800
254,699	520	820
280,169	540	860
308,186	560	900
339,004	600	920
372,905	620	960
410,195	640	1000
451,215	660	1100
496,336	680	1100
545,970	720	1100
600,567	740	1200
660,624	760	1200
726,686	800	1300
799,355	820	1300
879,290	860	1300
967,219	880	1400
1,063,941	920	1400
1,170,335	960	1500

FAN CASE 10		
Tubed axial (no straightening vanes) wheel size under 40 inches		
Q = flow rate (cm ³ /min)	Minimum Set-Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set-Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA
P = pressure (m. of water)		
Q * P	(m)	(m)
1,287,369	980	1500
1,416,106	1100	1600
1,557,216	1100	1600
1,713,488	1100	n/a
1,884,837	1200	n/a
2,073,320	1200	n/a
2,280,652	1300	n/a
2,508,717	1300	n/a
2,759,589	1300	n/a
3,035,548	1400	n/a
3,339,103	1400	n/a
3,673,013	1500	n/a
4,040,314	1500	n/a
4,444,346	1600	n/a
4,888,780	1600	n/a
5,377,659	n/a	n/a
5,915,424	n/a	n/a
6,506,967	n/a	n/a
7,157,663	n/a	n/a
7,873,430	n/a	n/a
8,660,773	n/a	n/a
9,526,850	n/a	n/a

PROPELLER FANS

FAN CASE II
Propeller all Sizes

Q = flow rate (cm ³)	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria 45 dBA
P = pressure (m. of water)		
Q*P	(m)	(m)
50	40	58
250	70	110
1,250	135	220
1,625	150	240
2,113	165	270
2,746	185	300
3,570	210	340
4,641	230	370
6,034	260	420
7,844	290	460
10,197	320	520
13,256	360	580
17,232	400	640
22,402	450	700
29,123	500	780
37,859	560	860
41,645	580	900
45,810	600	940
50,391	620	960
55,430	640	1000
60,973	660	1100
67,070	700	1100
73,777	720	1100
81,155	740	1200
89,270	780	1200
98,198	800	1300

FAN CASE II:
Propeller: all Sizes

Q = flow rate (cfm)	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria: 45 dBA
P = pressure (in. of water)		
Q*P	(m)	(m)
108,017	840	1300
118,819	860	1400
130,701	900	1400
143,771	920	1400
158,148	960	1500
173,963	1000	1500
191,359	1100	1600
210,495	1100	1600
231,545	1100	n/a
254,699	1200	n/a
280,169	1200	n/a
308,186	1300	n/a
339,004	1300	n/a
372,905	1300	n/a
410,195	1400	n/a
451,215	1400	n/a
496,336	1500	n/a
545,970	1500	n/a
600,567	1600	n/a
660,624	1600	n/a
726,686	n/a	n/a
799,355	n/a	n/a
879,290	n/a	n/a
967,219	n/a	n/a
1,063,941	n/a	n/a
1,170,335	n/a	n/a

FAN CASE 11
Propeller all Sizes

Q = flow rate (cfm) P = pressure (m. of water)	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria 45 dBA
Q*P	(m)	(m)
1,287,369	n/a	n/a
1,416,106	n/a	n/a
1,552,416	n/a	n/a
1,713,488	n/a	n/a
1,884,837	n/a	n/a
2,073,320	n/a	n/a
2,280,652	n/a	n/a
2,508,717	n/a	n/a
2,759,589	n/a	n/a
3,035,548	n/a	n/a
3,339,103	n/a	n/a
3,673,013	n/a	n/a
4,040,314	n/a	n/a
4,444,346	n/a	n/a
4,888,780	n/a	n/a
5,377,659	n/a	n/a
5,915,424	n/a	n/a
6,506,967	n/a	n/a
7,157,663	n/a	n/a
7,873,430	n/a	n/a
8,660,773	n/a	n/a
9,526,850	n/a	n/a

WASTE GAS FLARES

X: $7.75 * 10^{20}$ to $7.22 * 10^{21}$

$X = \frac{Q(V*d)^a}{v}$ <small>Q = Heating Rate (Watts) V = Flare tip velocity (m/s) d = diameter of stack (m) v = gas viscosity (m²/s) a = 2.1055</small>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
"X"	(m)	(m)
7.75E+20	470	805
9.69E+20	520	895
1.24E+21	580	n/a
1.51E+21	645	n/a
1.89E+21	715	n/a
2.37E+21	790	n/a
2.96E+21	880	n/a
3.70E+21	975	n/a
4.62E+21	n/a	n/a
5.78E+21	n/a	n/a
7.22E+21	n/a	n/a

INPUT DATA

Q = Heating Rate (Watts)
 V = Flare tip velocity (m/s)
 d = diameter of stack (m)
 v = gas viscosity (m²/s) *Kinematic*
 a = 2.1055

$X = \frac{Q(V*d)^a}{v}$

WASTE GAS FLARES

X: 1.5×10^{18} to 6.20×10^{20}

$X = Q(V+d)/r^2 a$ <small>Flaring Rate (Waste) Flaring Velocity (m/s) Diameter of stack (m) Flaring Velocity (m/s)</small>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	(m)	(m)
1.50E+18	35	60
1.88E+18	40	65
2.34E+18	45	70
2.93E+18	50	75
3.66E+18	55	80
4.58E+18	60	90
5.72E+18	65	95
7.15E+18	70	105
8.94E+18	75	110
1.12E+19	80	120
1.40E+19	85	135
1.75E+19	95	145
2.18E+19	100	160
2.73E+19	110	175
3.41E+19	120	195
4.26E+19	130	215
5.33E+19	145	235
6.66E+19	160	260
8.33E+19	175	285
1.04E+20	190	320
1.30E+20	210	350
1.63E+20	230	390
2.03E+20	255	430
2.54E+20	285	480
3.18E+20	315	530
3.97E+20	345	590
4.96E+20	385	655
6.20E+20	425	725

MOTORS

DRIP PROOF MOTORS 1/2 - 50 HP (DRIP PROOF SPLASH PROOF WEATHER PROOF) RPM: 450, 3600, HP: 1/2, 50, X: 4526, 941, 090		
$X = \text{RPM} \cdot \text{HP}^{1/3}$ RPM = rev/min HP = horse power	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria 45 dBA
"X"	(m)	(m)
4,526	4	6
4,978	4	7
5,476	4	7
6,023	5	8
6,625	5	8
7,288	5	9
8,017	6	9
8,818	6	10
9,700	6	11
10,670	7	12
11,737	7	12
12,911	8	13
14,202	8	14
15,622	9	15
17,185	9	16
18,903	10	18
20,793	11	19
22,873	12	20
25,160	12	22
27,676	13	23
30,443	14	24
33,488	15	25
36,837	16	26
40,520	17	27
44,572	19	28
49,030	20	30
53,932	22	31
59,326	23	33

DRPR MOTORS, 1 - 50 HP
{DRIP PROOF SPLASH PROOF WEATHER PROOF}
 RPM: 450 - 3600, HP: 1 - 50, X: 4526 - 941,090

$X = \text{RPM} \times \text{HP}^{.35}$ RPM = rev/min HP = horse power	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
65,258	24	34
71,784	25	36
78,963	26	38
86,859	27	40
95,545	28	42
105,099	30	45
115,609	31	47
127,170	33	50
139,887	34	54
153,876	36	56
169,263	38	60
186,190	40	64
204,809	42	68
225,289	44	72
247,818	47	76
272,600	50	82
299,860	54	86
329,846	56	95
362,831	60	100
399,114	64	105
439,025	68	115
482,928	72	120
531,221	76	130
584,343	82	140
642,777	86	145
707,055	95	160
777,760	100	170
855,536	105	180
941,090	115	190

DRPR MOTORS, 50 - 400 HP
{DRIP PROOF SPLASH PROOF, WEATHER PROOF}
RPM: 450 - 3600, HP: 50 - 400, X: 477,297 - 6,257,350

$X = HP \cdot RPM^{1.5}$ HP = horse power RPM = rev/min	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	(m)	(m)
477,297	17	27
525,026	18	27
571,528	19	28
635,281	19	29
698,809	20	30
768,690	21	31
845,559	22	32
930,115	23	33
1,023,127	24	34
1,125,439	24	35
1,237,983	25	36
1,361,782	26	38
1,497,960	26	39
1,647,756	27	40
1,812,531	28	42
1,993,785	29	43
2,193,163	30	45
2,412,479	31	47
2,653,727	32	48
2,919,100	33	50
3,211,010	34	55
3,532,111	35	55
3,885,322	36	60
4,273,854	38	60
4,701,240	39	65
5,171,364	40	65
5,688,500	42	70
6,257,350	43	70

DRPR MOTORS, 50 - 400 HP
{DRIP PROOF SPLASH PROOF, WEATHER PROOF}
RPM: 450 - 3600, HP: 50 - 400, X: 6,883,085 - 82,033,822

X = HP * RPM HP = horse power RPM = rev/min	<i>Minimum Set-Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set-Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
"X"	(m)	(m)
6,883,085	45	75
7,571,393	47	75
8,328,533	48	80
9,161,386	50	85
10,077,525	55	85
11,085,277	55	90
12,193,805	60	95
13,413,185	60	100
14,754,504	65	105
16,229,954	65	105
17,852,950	70	110
19,638,245	70	115
21,602,069	75	120
23,762,276	75	130
26,138,504	80	135
28,752,354	85	140
31,627,590	85	145
34,790,349	90	150
38,269,383	95	160
42,096,322	100	165
46,305,954	105	175
50,936,549	105	180
56,030,204	110	190
61,633,225	115	200
67,796,547	120	210
74,576,202	125	220
82,033,822	135	230

TEFC MOTORS, 1 - 50 HP
 {TOTALLY ENCLOSED FAN COOLED}
 RPM: 450 - 3600, HP: 1 - 50, X: 5,000 - 49,240

X=RPM*HP ^{1.33} RPM = rev./min HP = horse power	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA</i>
"X"	(m)	(m)
5,000	9	16
5,499	10	17
6,049	11	19
6,654	12	20
7,319	12	22
8,051	13	23
8,856	14	24
9,742	15	25
10,716	16	26
11,788	17	27
12,966	19	28
14,263	20	30
15,689	21	31
17,258	23	33
18,984	24	34
20,882	25	36
22,971	26	38
25,268	27	40
27,795	28	42
30,574	30	44
33,631	31	47
36,995	32	50
40,694	34	55
44,763	36	60
49,240	38	60

TEFC MOTORS, 1 - 50 HP
{TOTALLY ENCLOSED FAN COOLED}
RPM: 450 - 3600, HP: 1 - 50, X: 54,164 - 331,260

X = RPM - HP <small>RPM = rev/min HP = horse power</small>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
"X"	(m)	(m)
54,164	40	65
59,580	42	70
65,538	44	75
72,092	47	80
79,301	50	85
87,231	55	90
95,954	60	95
105,550	60	100
116,105	65	105
127,715	70	115
140,487	75	120
154,535	75	130
169,989	80	135
186,988	90	145
205,686	95	155
226,255	100	170
248,881	105	180
273,769	115	190
301,146	120	205
331,260	130	220

TEFC MOTORS, 50 - 400 HP
{TOTALLY ENCLOSED FAN COOLED}
RPM: 450 - 3600, HP: 50 - 400, X: 477,297 - 6,257,350

$X = HP \cdot RPM^{1.5}$ HP = horse power RPM = rev/min	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
X	(m)	(m)
477,297	33	55
525,026	34	55
577,528	35	55
635,281	37	60
698,809	38	60
768,690	39	65
845,559	41	65
930,115	42	70
1,023,127	44	70
1,125,439	45	75
1,237,983	47	80
1,361,782	49	80
1,497,960	55	85
1,647,756	55	90
1,812,531	55	90
1,993,785	60	95
2,193,163	60	100
2,412,479	65	110
2,653,727	65	115
2,919,100	70	120
3,211,010	70	125
3,532,111	75	120
3,885,322	80	130
4,273,854	80	135
4,701,240	85	140
5,171,364	90	150
5,688,500	90	155
6,257,350	95	160

{TOTALLY ENCLOSED FAN COOLED}
 RPM: 450 - 3600, HP: 50 - 400, X: 6,883,085 - 82,033,822

$X = HP \cdot RPM^{1.2}$ HP = horsepower RPM = rev/mm	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA
X	(m)	(m)
6,883,085	100	170
7,571,393	105	175
8,328,533	110	185
9,161,386	115	195
10,077,525	120	200
11,085,277	125	210
12,193,805	130	220
13,413,185	135	230
14,754,504	140	240
16,229,954	145	250
17,852,950	155	270
19,638,245	160	280
21,602,069	170	290
23,762,276	175	310
26,138,504	185	320
28,752,354	190	330
31,627,590	200	350
34,790,349	210	370
38,269,383	220	380
42,096,322	230	400
46,305,954	240	420
50,936,549	250	440
56,030,204	270	460
61,633,225	280	480
67,796,547	290	500
74,576,202	300	530
82,033,822	320	550

RPM: 450 - 900, HP: 1 - 100

HP	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criterio 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criterio 45 dBA</i>
	(m)	(m)
1	5	9
5	12	20
10	16	28
15	20	32
20	22	34
25	26	36
30	28	40
35	28	42
40	30	42
45	30	44
50	32	46
55	32	48
60	34	50
65	34	52
70	36	52
75	36	54
80	36	56
85	38	56
90	38	58
95	40	58
100	40	60

PUMPS
RPM: 450 - 900, HP: 101 - 1000

<i>HP</i>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	<i>(m)</i>	<i>(m)</i>
101	39	60
150	42	62
200	42	64
250	44	66
300	44	68
350	46	70
400	46	70
450	46	72
500	46	72
550	48	74
600	48	74
650	48	74
700	48	76
750	48	76
800	50	76
850	50	76
900	50	78
950	50	78
1000	50	78

PUMPS
RPM: 1000 - 1500, HP: 1 - 100

HP	Minimum Set-Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set-Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
1	7	12
5	14	26
10	20	32
15	24	36
20	28	40
25	30	42
30	32	46
35	32	48
40	34	50
45	36	52
50	36	54
55	38	56
60	40	58
65	40	60
70	42	62
75	42	64
80	44	66
85	44	68
90	44	68
95	46	70
100	46	72

PUMPS
RPM: 1000 - 1500, HP: 101 - 1000

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
101	46	72
150	48	76
200	50	78
250	52	80
300	52	85
350	54	85
400	54	85
450	54	85
500	56	90
550	56	90
600	56	90
650	58	90
700	58	90
750	58	95
800	58	95
850	58	95
900	60	95
950	60	95
1000	60	95

PUMPS
RPM: 1600 - 1800, HP: 1 - 100

HP	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA</i>
	(m)	(m)
1	12	20
5	25	36
10	31	46
15	36	54
20	39	60
25	42	66
30	45	70
35	48	74
40	50	78
45	52	82
50	54	86
55	56	90
60	58	92
65	60	96
70	62	98
75	64	105
80	66	105
85	68	110
90	68	110
95	70	115
100	72	115

PUMPS
RPM: 1600 - 1800, HP: 101 - 1000

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria: 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria: 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
101	72	115
150	76	120
200	78	125
250	80	130
300	82	130
350	84	135
400	84	135
450	86	140
500	86	140
550	88	145
600	88	145
650	90	145
700	90	145
750	92	150
800	92	150
850	92	150
900	94	150
950	94	155
1000	94	155

Pumps
RPM: 3000 - 3600, HP: 1 - 100

hp	Minimum Set Back Distance	Minimum Set Back Distance
	Day-Time 07:00 - 19:00 Criteria: 50-dBA (m)	Night-Time 19:00 - 07:00 Criteria: 45-dBA (m)
1	8	14
5	18	29
10	25	36
15	29	42
20	32	46
25	34	50
30	36	54
35	38	58
40	39	60
45	41	62
50	42	66
55	44	68
60	45	70
65	46	72
70	48	74
75	49	76
80	50	78
85	52	80
90	52	82
95	54	84
100	54	86

Pumps
RPM: 3000 - 3600, HP: 100 - 1000

HP	Minimum Set Back Distance Day Time 07:00 - 19:00 Criteria: 50 dBA	Minimum Set Back Distance Night Time 19:00 - 07:00 Criteria: 45 dBA
	(m)	(m)
101	54	86
150	58	90
200	60	94
250	60	96
300	62	98
350	64	100
400	64	105
450	66	105
500	66	105
550	66	110
600	68	110
650	68	110
700	68	110
750	70	110
800	70	115
850	70	115
900	70	115
950	72	115
1000	72	115

PUMPS HIGH PRESSURE OPERATION
RPM: 1600 - 1800, HP: 1 - 100

<i>HP</i>	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
	<i>(m)</i>	<i>(m)</i>
1	22	34
5	39	60
10	50	78
15	58	92
20	66	105
25	72	115
30	76	125
35	82	135
40	86	140
45	90	150
50	94	155
55	98	160
60	105	165
65	105	170
70	110	175
75	115	180
80	115	185
85	120	190
90	120	195
95	125	200
100		

PUMPS HIGH PRESSURE OPERATION,
RPM: 1600 - 1800, HP: 101 - 1000

HP	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
101	126	205
150	132	215
200	138	225
250	145	230
300	145	235
350	150	240
400	150	245
450	155	245
500	155	250
550	160	255
600	160	255
650	160	260
700	165	260
750	165	260
800	165	265
850	165	265
900	170	270
950	170	270
1000	170	270

PUMPS HIGH PRESSURE OPERATION,
RPM: 3000 - 3600, HP: 1 - 100

HP	Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA	Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA
	(m)	(m)
1	16	28
5	31	46
10	39	60
15	45	70
20	50	78
25	54	86
30	58	92
35	62	98
40	66	105
45	68	110
50	72	115
55	74	120
60	76	125
65	80	130
70	82	135
75	84	135
80	86	140
85	88	145
90	90	150
95	92	150
100	94	155

**PUMPS HIGH PRESSURE OPERATION,
RPM 3000 - 3600, HP: 101 - 1000**

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
101	94	155
150	100	160
200	105	170
250	110	175
300	110	175
350	110	180
400	115	185
450	115	185
500	115	190
550	120	190
600	120	195
650	120	195
700	120	195
750	125	200
800	125	200
850	125	200
900	125	205
950	125	205
1000	130	205

STEAM TURBINES

	<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
<i>HP</i>	<i>(m)</i>	<i>(m)</i>
500-1,500	75	120
1,501-5,000	100	160
5,001-15,000	140	220

HIGH PRESSURE THERMALLY INSULATED STEAM VALVES & NEARBY PIPING

<i>Minimum Set Back Distance Day-Time 07:00 - 19:00 Criteria 50 dBA</i>	<i>Minimum Set Back Distance Night-Time 19:00 - 07:00 Criteria 45 dBA</i>
(m)	(m)
78	120

The above analysis is applicable to high pressure steam lines.

