The use of synthetic noise generators in French airports

(J.L. Briot, France)

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(J.L. Briot - Service Technique de la Navigation Aerienne)
FRANCE

Abstract:

This paper summarizes seven years of research in France with different noise generators. The latest type of equipment manufactured in France is described. Visual observations and birdstrikes are analyzed, the results discussed and the future considered.

I - Test chronology

This chapter gives a very brief summary of the various tests conducted since 1981 with noise generators of different types:

1981: Test of the "Avalarm" ST4 model

1982-1983: Test of the "Avalarm" ST100 B2 model at LFPG.
Original equipment comprises 2 loudspeakers on a mast, powered by a 30 W amplifier (Photo 1).

1984-1985: Increase in the emission power of the Avalarm ST100 B2 by addition of a 240 W amplifier powering 7 loudspeakers located every 150 m, 80 m from the edge of the runway. Test at LFPG in winter on two 900 m sections of runway.

Study of a prototype synthesizer conducted by the Centre National de la Recherche Scientifique (CNRS) capable of producing digitized distress calls and Avalarm type signals.

1985-1986: Installation of a line of loudspeakers covering two thirds of runway 07/25 at LFPO, powered by 2 Avalarms and three 240 W amplifiers (photo 2).

Comparison with a hawk experiment at LFPG.

Tests with digitized distress calls from a vehicle.

1986-1987: Manufacture of a preseries of 10 French synthesizers

Definition of the equipment required to broadcast the biological or artificial signals over a full runway.

Installation of noise generators on 2 runways at LFPG, 1 runway at LFBD, 1 runway at LFBT and 1 at LFPO(photos 3,4,5)

Test of biological and artificial signals on these airfields.

1987-1988: Installation of noise generators on 1 runway at LFMN and LFRJ.

Doubling of the number of loudspeakers at LFPG.

Study of the reduction in the problem brought about by these noise generators.

Series production of fixed and vehicle-borne noise generators (Photos -6,7)

II. Results

II.2 Bird observations

The first tests conducted with the Avalarm ST4 gave disappointing results for both lapwings and gulls.

Birds were observed in front of the working loudspeakers. The reasons for this failure were probably the signal spectrum, the very low emission power (10 W) and the poor efficiency of the loudspeakers used.

Initially, the Avalarm ST100 B2 posed considerable problems since the manufacturer provided no instruction manual. After a large number of tests with the original item, the following observations were made with lapwings (V. vanellus) in winter at LFPG:

- the best results, characterized by the number of lapwings on the ground around the loudspeakers, were obtained with a low frequency and high emission rate (30 seconds of emission for every minute of silence),
- addition of a blaster did not give better results,
- the area covered is about 100 m in front of each source,
- there is no habituation and the same signal can be played at the same rate for several days in a row.

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Broadcasting this type of signal over sections or complete runways confirms these results at Roissy and Orly:

- When the loudspeakers are working, the lapwings and gulls settle behind the speakers or in areas which are not covered by them,

- only 1 to 5% of the bird population frequenting the edges of the runways can be observed in the grass in front of the loudspeakers, in particular when the wind conditions are right, and even then in areas where the noise is lowest (between two loudspeakers),

- as soon as the broadcast stops, the birds gradually come back in front of the loudspeakers and right up to the runway (no difference after 2 hours stoppage),

- certain individuals sometimes land on the runways in front of a loudspeaker which is working. They tolerate one or two emissions, but remain wary and uncertain and always finish by flying away.

- birds in flight which cross the runway almost never react and at best gain height slightly (woodpigeon).

The commissioning of French synthesizers capable of playing several types of signals and the installation of high performance loudspeakers along the complete runway has led to the following conclusions:

- to worry the birds, the signal broadcast must be non-harmonic and have a high acoustic level over the entire area to be covered (80 dBA along the runway axis),

- this signal must comprise two noises lasting 150 ms, with a spectrum centered on 3 unharmonic frequencies(f1=2150Hz,f2=1,8f1,f3=2,95f1)see appendix

- if the periods of silence are too long, birds can return between two emissions, 30 seconds of signal for one minute of silence seems to be a good rate,

- the level of background noise, the height of the loudspeakers, their performance, their directivity curve and above all their position in relation to the prevailing winds, are extremely important factors with this type of signal, which must be clearly distinguishable from the background noise if it is to be effective,

- finally, these artificial signals proved to be effective on lapwings (V. vanellus), black headed-gulls (Larus ridibundus), and woodpigeons (Columba palumbus). However, they would appear to have no effect on birds of prey (Milvus migrans, Falco tinunculus), gallinaceans (Perdix perdix) crows (Corvus frugilegus)and starlings (Sturnus vulgaris).

The comparison between the biological signals (synthesized distress calls) and the natural signals was made by the CNRS and our department. There appeared to be no significant difference between the reactions of the birds to the synthetic signals played by a synthesizer and the natural signals recorded on magnetic tape (see appendix 2). These comparisons concerned the black-headed gull (L. ridibundus), the herring gull (L. argentatus), the lapwing (V. vanellus), and the starling (Sturnus vulgaris). An inter-species signal giving good results on these 4 species, plus the rook (Corvus frugilegus) was also created by the CNRS (appendix 3). The attraction of the birds to the sound source (positive tropism) is less marked with this signal than with the natural signals.

The emission of these biological signals from loudspeakers installed along the runways poses two types of problems:

- if they are played too often, even if irregularly, the phenomenon of habituation appears,

- automatic broadcasting, irrespective of air traffic, is extremely dangerous. This results in hundreds or even thousands of birds taking wing at the same time, even if settled far from the runways, which could interfere with aircraft movements.

These signals should therefore be reserved for manual triggering at appropriate moments during lulls in traffic:
- either from loudspeakers installed along the runways to clear the verges,
- or from a runway vehicle linked up to the control tower to carry out isolated operations on clearly identified groups of birds.

III - Birdstrike statistics

Birdstrike statistics are always open to criticism and difficult to interpret owing to the many factors involved:

- the way in which information is collected varies from one year to the next (the more attention paid to the bird risk on an airfield, the more collisions are discovered through the number of dead birds found on the runways, for example),

- years are never the same from an ornithological point of view, owing to the meteorological variations recorded from 1 winter to the next,

- the number of events on which the statistics are based are low after elimination of those cases in which the runway, the time and the altitude are unknown.

Nonetheless, a study of the tables given in appendix 4 identifies some encouraging trends:

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- the number of incidents resulting in damage has fallen from 11 per year at LFPG, LFPO, LFBD (average obtained between 1984 and 1986) to 1 per year in 1987 on the runways equipped with noise generators. This single incident was in fact recorded on runway 10/28 at LFPG whose installation proved to be defective this winter (many loudspeakers unserviceable). The number of serious incidents has either not varied or has increased on runways not equipped (such as Orly). These serious incidents have always been well logged,

- the total number of birdstrikes recorded on the ground over the three airports has gone from 21/year to 7/year on the runways equipped with noise generators (2 with partridge, 1 with a rook, 1 with a gull and 3 with unidentified birds),

- the number of birdstrikes recorded at above ground level has not changed (46 before the scarers, 44 after).

Unfortunately, the situation at Tarbes (LFBT) has not changed regarding the Black Kite (Milvus migrans) showing either that this signal has no effect on this species, or that there is a lack of power on the runway linked to that the fact that the loudspeakers are lower, spaced too far apart (200m)and less powerful.

IV - EQUIPMENT USED

Two equipment assemblies are currently available:

- for airfields on which installation of noise-generators along the runways is not envisaged (few birdstrikes, problems with local inhabitants, etc.), one or two runway vehicles (or SSIS) are equipped with "mobile" synthesizers. This extremely practical vehicle-mounted system comprises 1 CSSE synthesizer capable of playing 4 specific distress calls and 1 multi-species call, 1 AMD 30SB/M amplifier of 30 Watts. It is powered by the vehicle's 12-volt battery. The technical characteristics of the equipment are given in appendix 5(photos 6-7)

- equipping a 3600 m runway with fixed noise-generators requires the following equipment: 1 rackable CSSE synthesizer powered with 220 V, set to the alternating signal position, 3 240 Watt amplifiers, 48 30 Watt loudspeakers, Hpc 40T, 24 masts of 2.5 m, 4000 m of two-wire 2 x 4 or 6 mm² cable (see appendix 6). Spares, an on-off remote control, a programmable startup clock, and a loudspeaker lines remote monitoring system (included in the AMS 240 amplifiers) must also be provided. The installation control and monitoring decks can be installed in the runway offices or the control tower (photo 5). A temporary installation can be made using cable laid on the ground but line breaks are frequent (mowing, rabbits!). A correct and definitive installation requires that the cables be buried, which can be carried out at lower cost if advantage is taken of a runway lighting renovation operation.

V - Discussion

The advantages of using fixed noise-generators can be summarized as follows:

- the cost-efficiency of the method is highly satisfactory (heavy investment to start with, negligible subsequently),
- the method is automatic, works in all weathers (except for violent winds blowing straight into the loudspeakers), from sunrise to sunset. It guarantees a certain degree of safety all year round without any need for intervention by the airport personnel,
- the equipment used is extremely reliable (only a few loudspeaker failures have been recorded with the first series, which has now been modified),
- the method is effective against a large number of species which constitute a danger for air traffic (gulls, lapwings, pigeons),
- it is well-adapted to French legislation which in priority requires removal of birds located on the runways. The State or the Managing Authority cannot be held responsible for birdstrikes which occur in the air,
- finally, the broadcasting of digitized distress calls during traffic lulls means that all the birds on the verges can be scared quickly and all at once, even far behind the loudspeakers.

The main drawback of this method is linked to the sound pollution experienced by persons located on either side of the noise generators (personnel working on the runways, fire brigade, or even outside the airport perimeter). The noise measurements show that the nuisance created by the signal depends on the direction of the wind, even at 250 m behind the loudspeakers (emergence of 5 to 10 dBA).

To limit this nuisance, the following steps must be taken:

- the number of sound sources must be increased to provide better distribution of the signal along the runway while at the same time reducing the emitted noise (appendix 7)
- the loudspeakers should be installed lower (40 cm above the ground) to increase absorption by the ground and reduce the effect of the wind),
- noise screens should be installed behind the loudspeakers (photo 8 and appendix 8).

An installation of this type comprising 75 loudspeakers is being set up on runway 08-26 at Orly. We will have to wait until next winter to see whether this new layout changes anything regarding the results obtained with the birds.

The second drawback lies in the fairly limited surface covered by the loudspeakers (the runway ± 45 m depending on the wind). When thousands of gulls and lapwings are present on the platforms just behind the loudspeakers, the crews can feel it necessary to abort take-off, even if there has been no collision, in particular if the birds are disturbed (security patrol, very noisy aircraft, fox, etc.).

In periods of intense bird activity, it is therefore necessary to use either conventional bird-scaring methods or to broadcast specific distress calls with noise-generators during lulls in traffic.

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Finally, the third drawback is linked to the bad results obtained on birds of prey and gallinaceans, which should be improved, at least at LFBT, in 1988, by the installation of equipment with higher performance, thus avoiding the more costly incidents. It will nonetheless be necessary to retain the option of using more conventional bird-scaring methods (distress calls, pyrotechnics, hunting) during the periods of intense bird activity, using a small number of well-trained personnel.

In 1988, the equipping of a new runway at Orly, the doubling of the number of loudspeakers at Bordeaux, Nice, Roissy and Tarbes should improve even further the results obtained, as well as defining the effect of the method on other species (herring gull - Larus argentatus, and Black Kite - Milvus Migrans).

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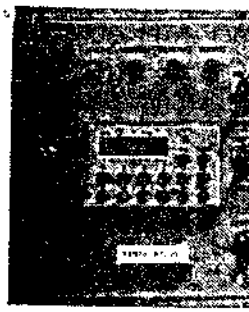

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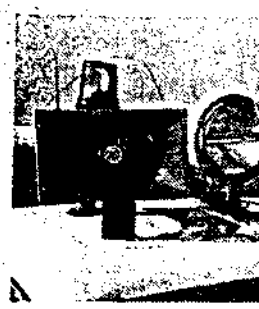

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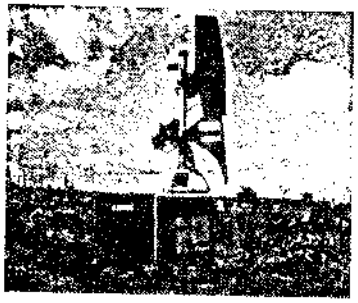

AV ALARM ST 100 B2 MODEL

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FIRST LINE OF LOUDSPEAKERS AT LFPO

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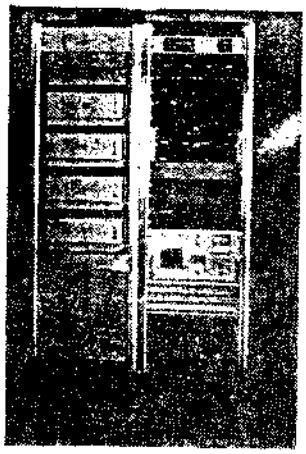

EQUIPMENT USED FOR ONE RUNWAY

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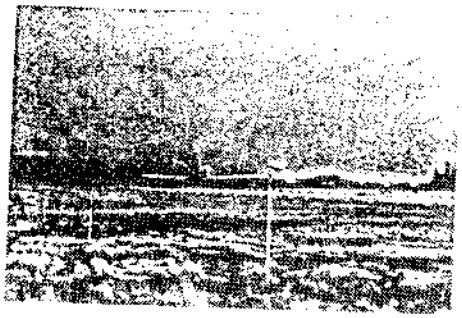

BACK LINE OF LOUDSPEAKERS AT LFPO

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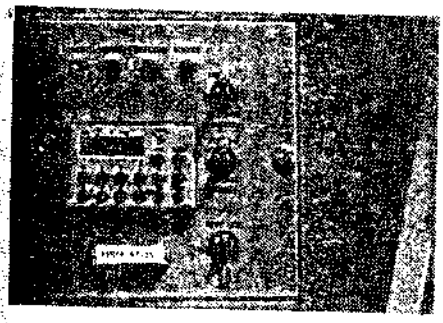

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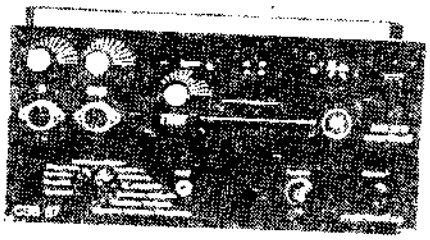

MOBILE SYNTHESIZER

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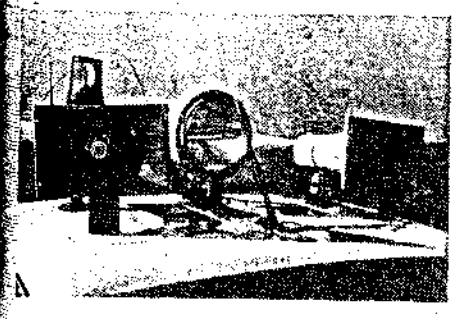

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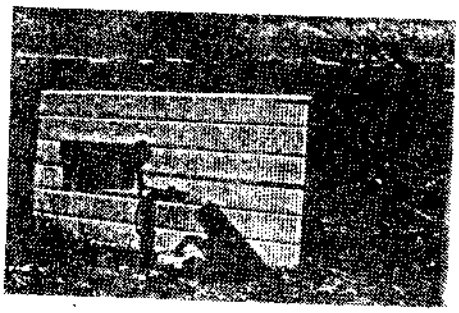
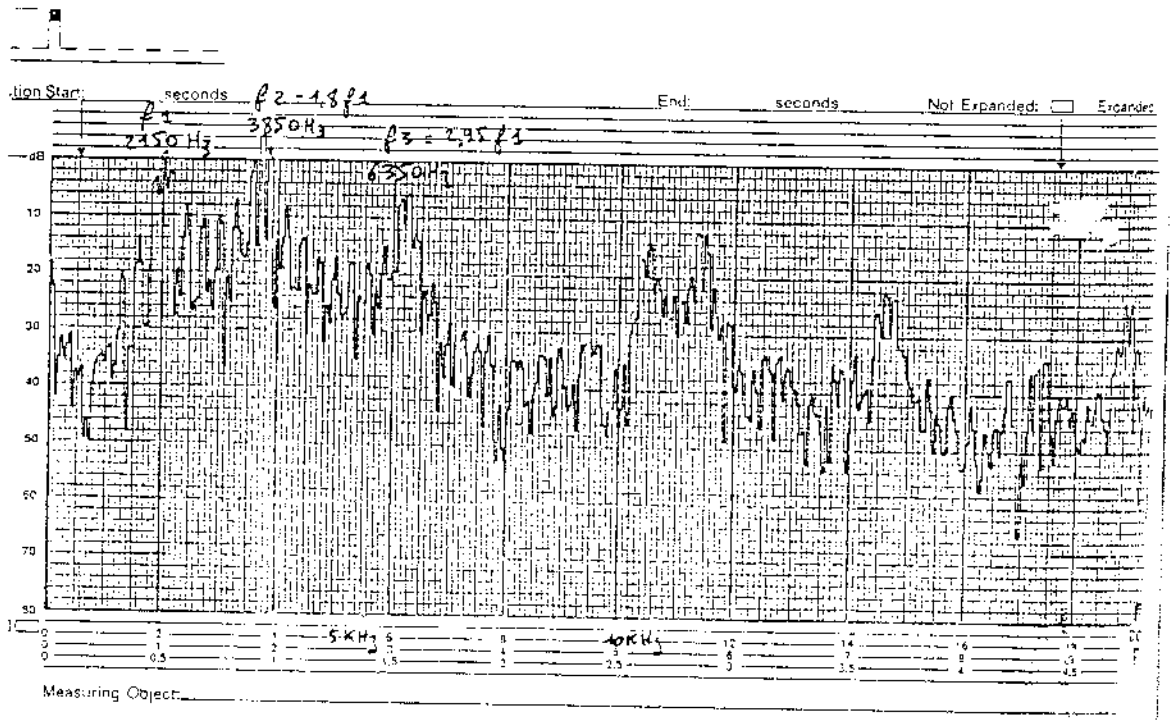
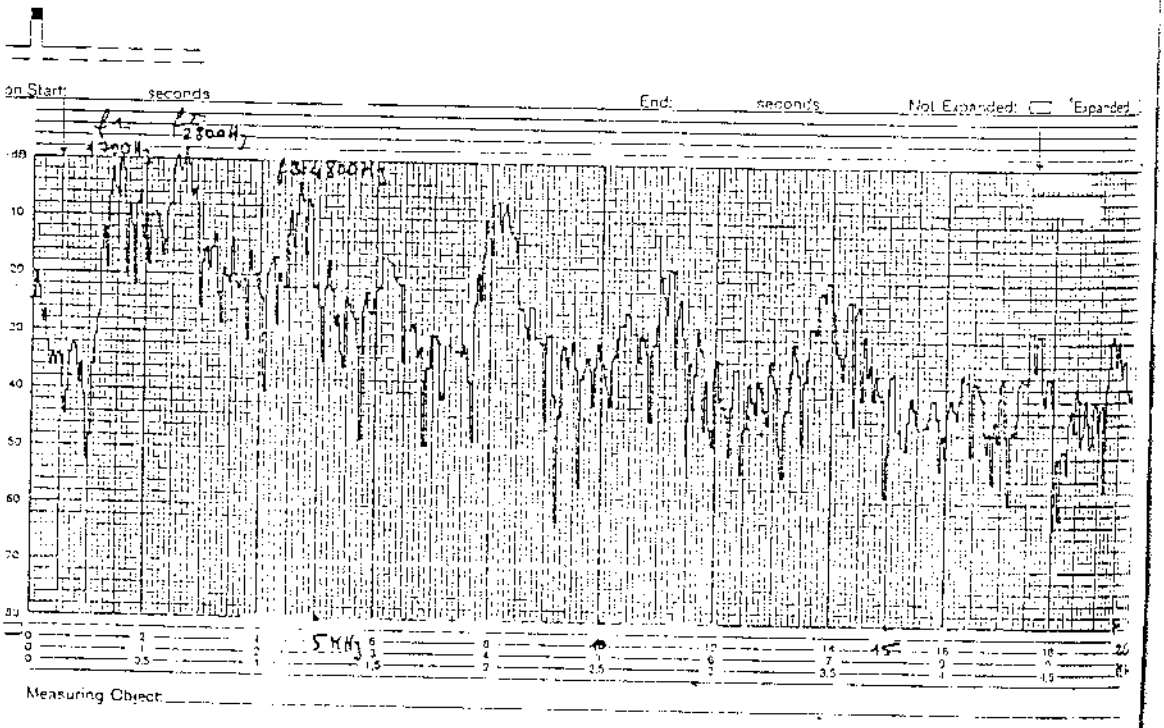


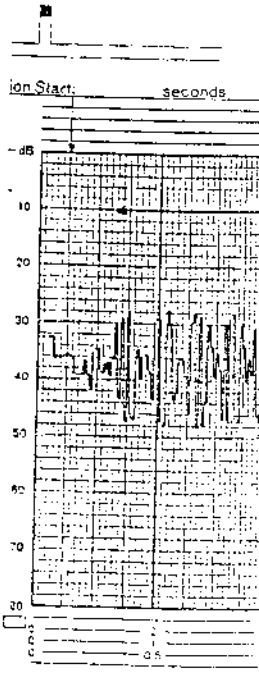
NOISE SCREEN BEHIND A LOUDSPEAKER

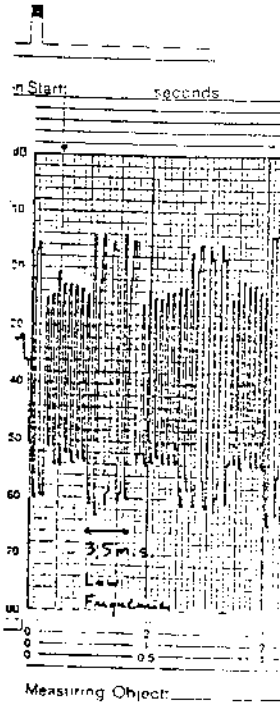
Appendix

Spectrum of the artificial signal.



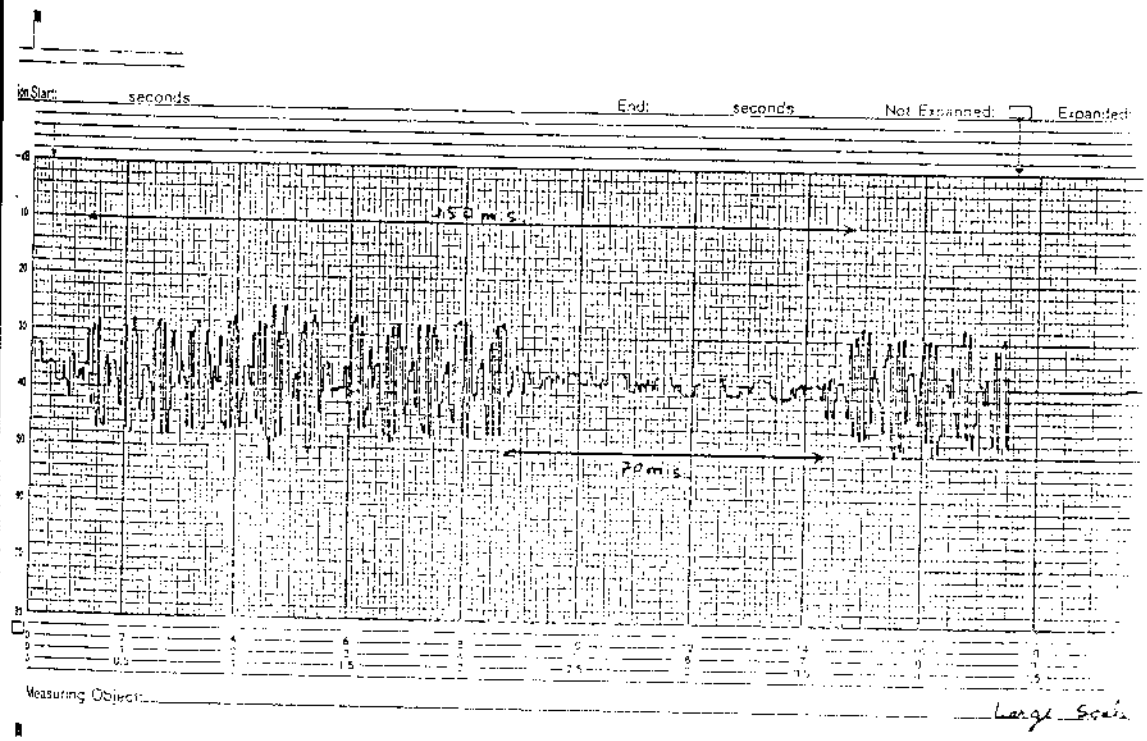


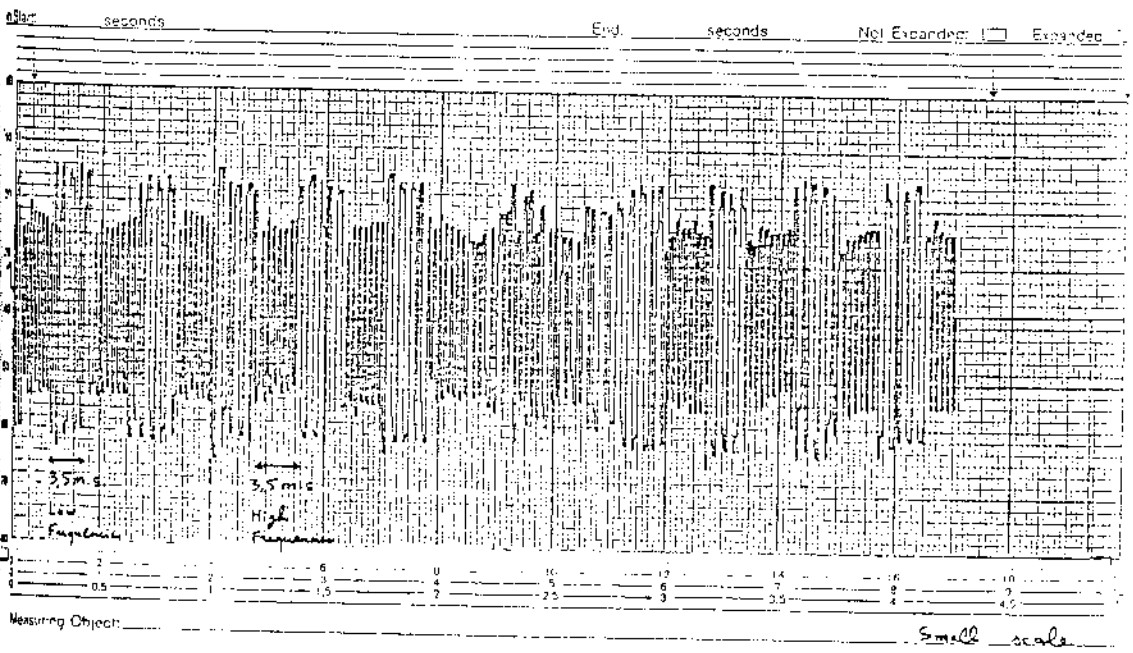




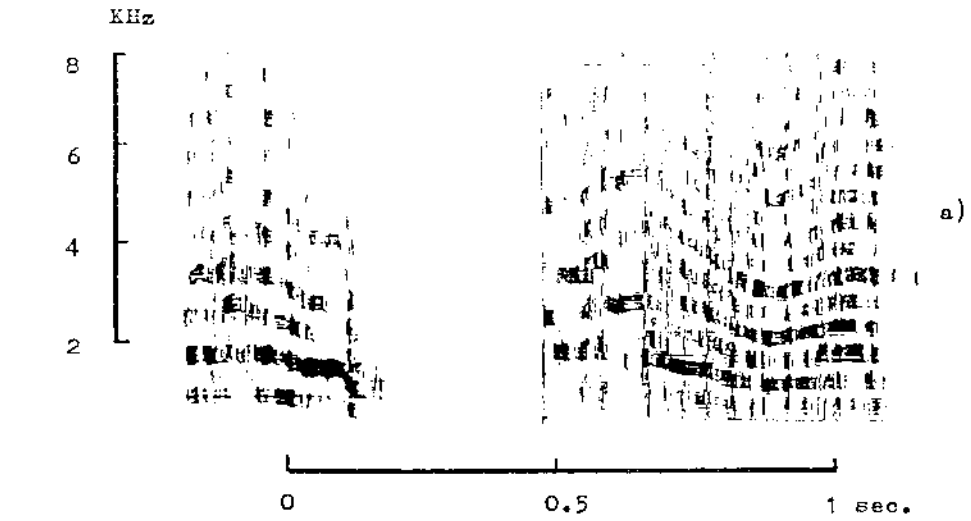
Appendix 1

Temporal evolution of the signal.





APPENDIX 2



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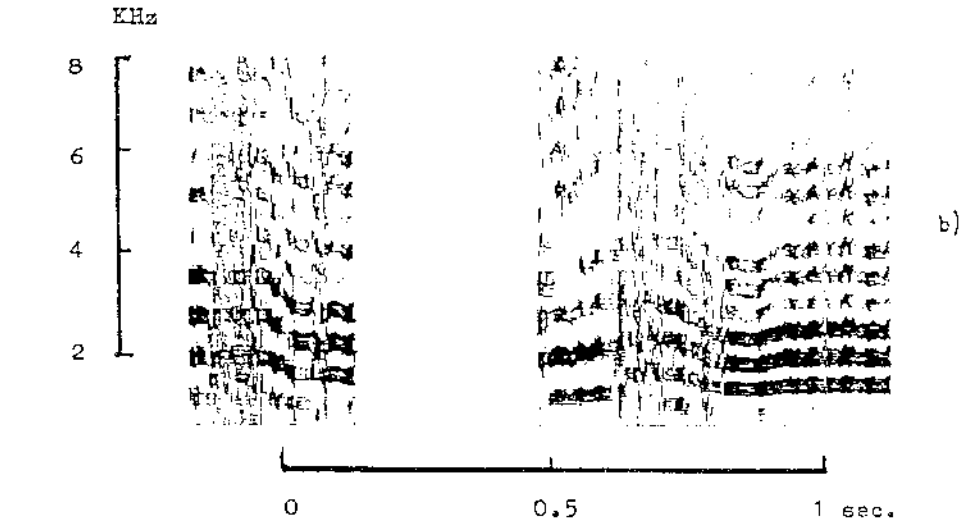

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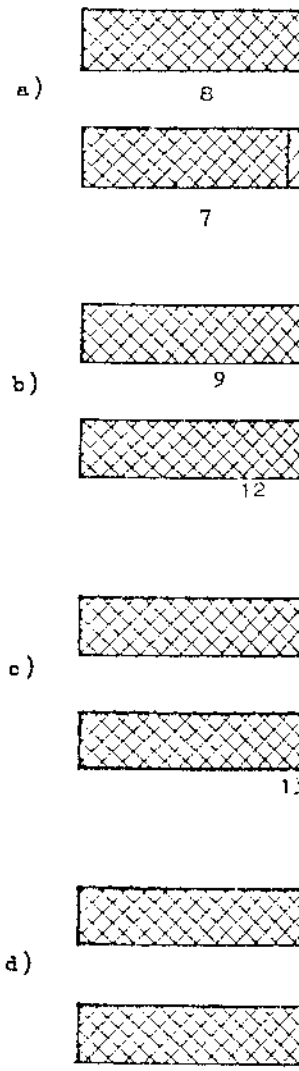
Sound spectrogram of a herring gull (Larus argentatus)



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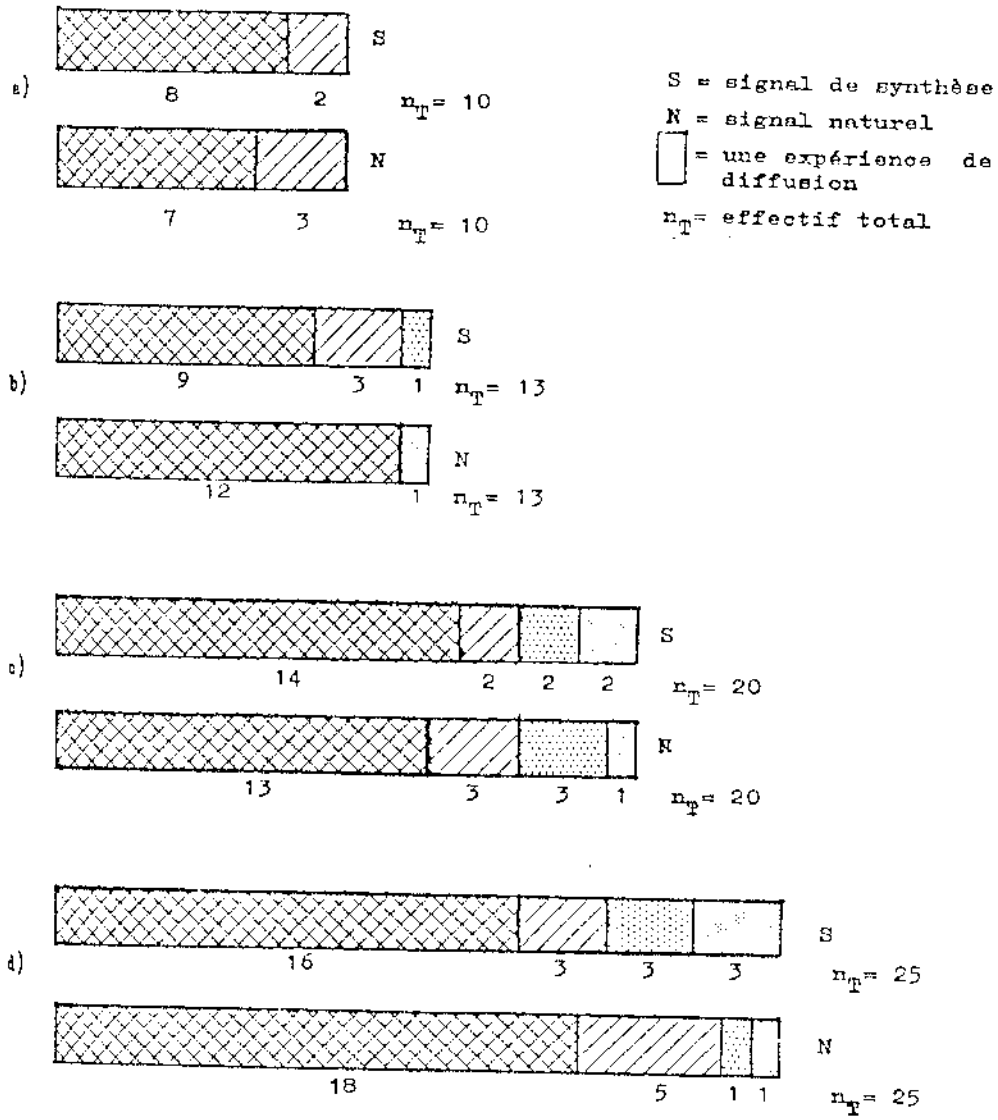

Figure 7: réactions des oiseaux aux signaux de détresse (synthèse et naturel).
diffusions sur: - a) mouette rieuse
- b) goéland argenté
- c) corbeau freux
- d) étourneau sansonnet

APPENDIX 2

Proportion d'oiseaux réagissant	envol	venue vers la source sonore	dispersion finale après survol	cotation, symbole et dénomination	
tous	immédiat et rapide	rapide	après 2mn	+++	Forte intensit
presque tous	rapide	rapide	entre 1mn30s et 2mn	++	réactions de détress typiques
la majorité	± rapide	± rapide	avant 1mn30s	+	faible intensit
une minorité	± rapide	± rapide	avant 1mn	+0 +0- +-	réaction mixtes détresse fuite
tous	oui	non	fuite	-	fuite

Figure 6: résumé des bases de cotation des réactions des oiseaux aux signaux diffusés (d'après BUSNEL & GIBAN, 1965).

ESPECE TESTEE	SIGNAL TESTE
Etourneau *Sturnus vulgaris*	Témoin
	Interspe
Vanneau *Vanellus vanellus*	Témoin
	Interspe
Corbeau Freux *Corvus frugilegus*	Témoin
	Interspe
Mouette Rieuse *Larus ridibundus*	Témoin
	Interspe

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APPENDIX 3

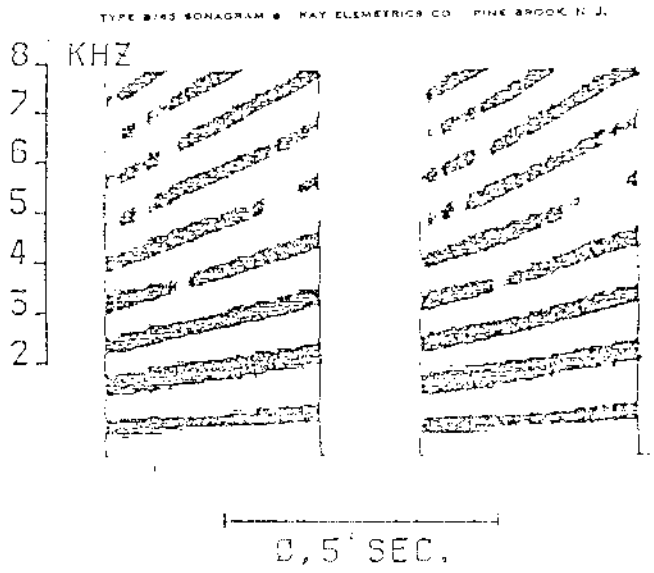
ESPECE TESTEE	SIGNAL TESTE	NBRE DE TESTS	REPONSES NEGATIVES Classes 0 / 1 / 2 / 3 nbre (%)	REPONSES POSITIVES	RESULTATS STATISTIQUES χ^2_c
Bourreau	Témoin	25	2(8) 1(4) 1(4)	23(92) 5(20) 18(72)	N.S.*
Moineau	Interspe 1	20	3(15) 2(10) 1(5)	17(85) 6(30) 11(55)	
Moineau	Témoin	18	1(6) 0(0) 1(6)	17(94) 8(44) 9(50)	N.S.*
	Interspe 1	15	3(20) 0(0) 3(20)	12(80) 7(47) 5(33)	
Corbeau	Témoin	20	4(20) 2(10) 2(10)	16(80) 3(15) 13(65)	N.S.*
	Interspe 1	15	4(27) 0(0) 4(27)	11(73) 4(27) 7(46)	
Mouette	Témoin	13	1(8) 0(0) 1(8)	12(92) 3(23) 9(69)	N.S.*
	Interspe 1	12	4(33) 2(165) 2(165)	8(67) 5(42) 3(25)	

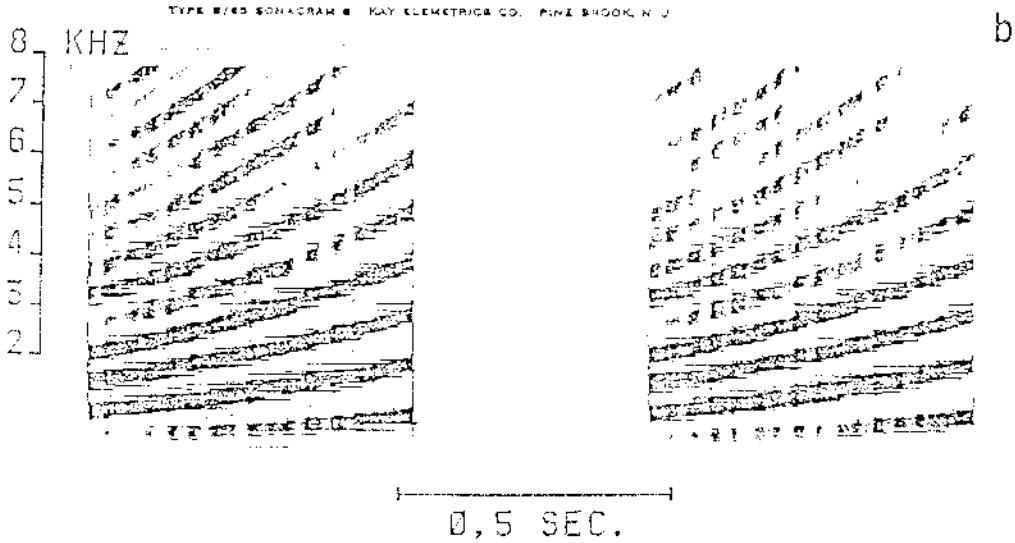
Different birds species reactions to interspecific signal

Figure 3: réactions de différentes espèces au signal INTERSPE 1. Pour chaque espèce, les résultats des diffusions de ce signal sont comparés à ceux des diffusions de signaux de synthèse de cris de détresse appartenant à l'espèce testée (témoin).

* N.S. = différence non significative test du χ^2_c avec $p < 0.05$.

APPENDIX 3





Sound spectogram of two interspecific signals

LFPO

Birdstrikes on the
Birdstrikes with sc out of service
Birdstrikes over th or height unknown
Birdstrikes with da
Aborted take off wi in

Rwy25:equiped wit
RwyC8:unequiped

LFPG

Birdstrikes on the s
Birdstrikes with sca out of service
Birdstrikes over the or height unknown
Birdstrikes with dam
Aborted take off wit imp

Rwy 27: noise gen

Rwy 28: noise gen

APPENDIX 4

LFPO	1984			1985			1986			1987		
Rwy	25	08	?	25	08	?	25	08	?	25	08	?
Birdstrikes on the Rwy	8	12		6	7		2	5		2	9	
Birdstrikes with scarers out of service							5			2		
Birdstrikes over the Rwy or height unknown	5	7	13	8	15	6	9	13	5	11	14	3
Birdstrikes with damages	3	1	3	3	2	0	4 (*)	2			5	
Aborted take off without impact							3			2		

Rwy25: equiped with noise generators

Rwy08: unequiped

(*) 3 during noise generators failures.

LFPG	1984			1985			1986			1987		
Rwy	28	27	?	28	27	?	28	27	?	28	27	?
Birdstrikes on the Rwy	6	4		6	4		6	9		4	1	
Birdstrikes with scarers out of service												
Birdstrikes over the Rwy or height unknown	14	23	14	19	17	12	8	31	22	10	18	27
Birdstrikes with damages	4	3	2	3	2	3	2	5	5	1	0	3
Aborted take off without impact												

Rwy 27: noise generators, 2 loudspeakers on each mast

Rwy 28: noise generators, 1 loudspeakers on each mast

APPENDIX 4

noise generators

LFBD	1984			1985			1986			1987		
Rwy	29	23	?	29	23	?	29	23	?	29	23	?
Birdstrikes on the Rwy		4		1	3			5		3	1	
Birdstrikes with scarers out of service											2	
Birdstrikes over the Rwy or height unknown	2	3			5		1	1		5	3	
Birdstrikes with damages	1	1			1			1				
Aborted take off without impact												

Rwy 29: unequiped

Rwy 23: equiped with noise generators

noise generators

LFBT	1984			1985			1986			1987		
Rwy	03			03			03		?	03		
Birdstrikes on the Rwy	8			6			10			15		
Birdstrikes with scarers out of service												
Birdstrikes over the Rwy or height unknown	7			19			11			13		
Birdstrikes with damages	4			3			0			1		
Aborted take off without impact												

BIRD STRI

1. INTRODU

The CSS 87 is a di
and horn speakers

2. DESCRIPT

The CSS 87 is au

a) Portable type

Black painted meta
DC. The two assem
bracket.

FRONT

1 2 3

REAR

1- 11 Positi
2- Reset sw
3- 1 A Fus
4- ON / OF

5-Connecti
3
4
1. 2
5

BIRD STRIKE NOISE GENERATOR

CSS 87

1. INTRODUCTION

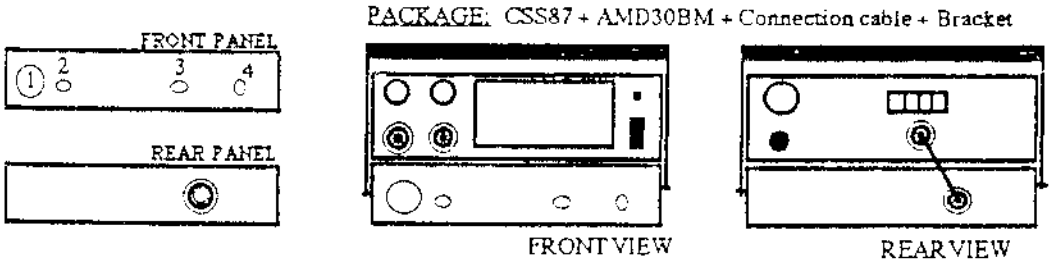
The CSS 87 is a digital noise generator, when used together with our power amplifiers and horn speakers, allows the broadcasting of different signals and bird distress sounds.

2. DESCRIPTION

The CSS 87 is available in two types :

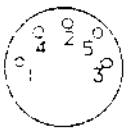
a) Portable type : CSS 87 M

Black painted metal sheet body to be used with our amplifier ref AMD 308 M 30W/12V DC. The two assembled units may be easily installed in a vehicle by means of a U shape bracket.



1- 11 Positions sound selector switch
2- Reset switch (RAZ)
3- 1 A Fuse
4- ON / OFF Switch

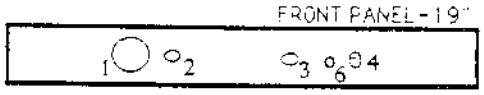
5-Connectionreceptacle
3 Signal output
4 + 12V DC input
1, 2 Ground
5 Remote control (AMD 30)

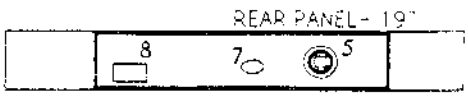


merlaud s.a.
76 Bd VICTOR HUGO 92114 CLICHY - FRANCE
Tel : (1) 47 37 75 14 Tlx : 614 600 F Fax : (1) 47 37 53 10

b) Rack mounting type ref CSS 87 R

19"-1U standard black painted metal sheet body designed to be mounted in 19" rack. This model has a 220V/12V DC built-in power supply. Its output signal (-10dB/600Ω) may drive up to about 20 of our amplifiers having their inputs connected in parallel.

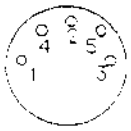




1- 11 Positions sound selector switch
2- Reset switch (RAZ)
3- 1A Fuse
4- ON/OFF Switch

6- "ON" indicator lamp
7- Mains fuse 05 A
8- 220V - AC supply

5-Connectionreceptacle:



3 Signal output
4 External + 12V DC input
1, 2 Ground
5 Remote control

3. OPERATION

a) Portable type ref CSS 87 M

- Connect the CSS 87 M to AMD 30 B M amplifier using adequate cable cord supplied with equipment
- Connect + 12V DC to AMD 30 B M
- Turn on both units
- Use "RESET" button (RAZ) to start a cycle
- Set "SOUND SELECTOR SWITCH" to requested sound and reset (RAZ button) to start the cycle

b) Rack mounting type ref CSS 87 R

- Connect your CSS 87 R to mains supply
- Connect output signal (N° 5) to power amplifiers inputs
- Turn on (CSS 87 R + amplifiers)
- Use "RESET" button (RAZ) to start a cycle
- Set "SOUND SELECTOR SWITCH" to requested sound and reset (RAZ Button) to start the cycle

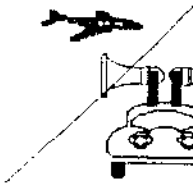
4. AVAILABLE SOUNDS

1-SEA GULL
2- GULL
3- LAPWINGS
4- STARLING
5- INTERSPECIFIC (Mixed sounds)
6- ALARM ≈ : CONTINUOUS ALARM
7- ALARM ~ : ALTERNATIF ALARM
8- HAZARDOUS ALARM
9- SEA GULL + GULL
10- GULL + LAPWINGS
11- GULL + LAPWINGS + STARLING

5. APPLIC

a) Bird strikes

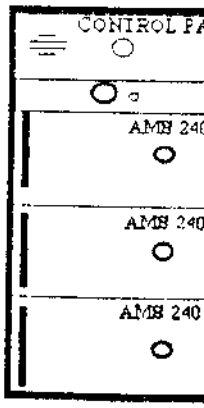
1. Required eq



2. Method
- Draw near bird
- Stop your vehic
- Indentify birds
- Turn on the AM
- Set sound select
- Should you have
- Turn on the CSS
- Use reset buttor
- Broadcast the so
- Should the birds shotguns and sp birds fly in a di
- In order to avoi sound by natura

b) Bird strikes u

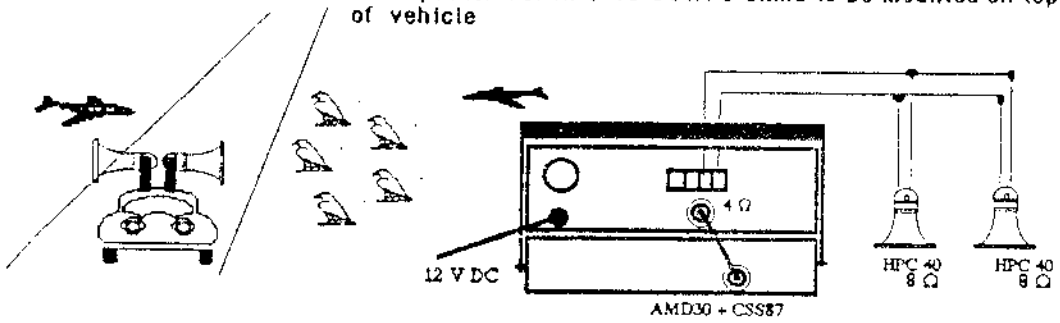
1. Required equi



5. APPLICATION

a) Bird strikes using portable system

1. Required equipment : - Noise generator ref CSS 87 M
- 30W/12V DC amplifier ref AMD 30 B M
- Autoreverse cassette player ref TMK
- Horn speaker ref HPC 40 30W/8 Ohms to be mounted on top of vehicle

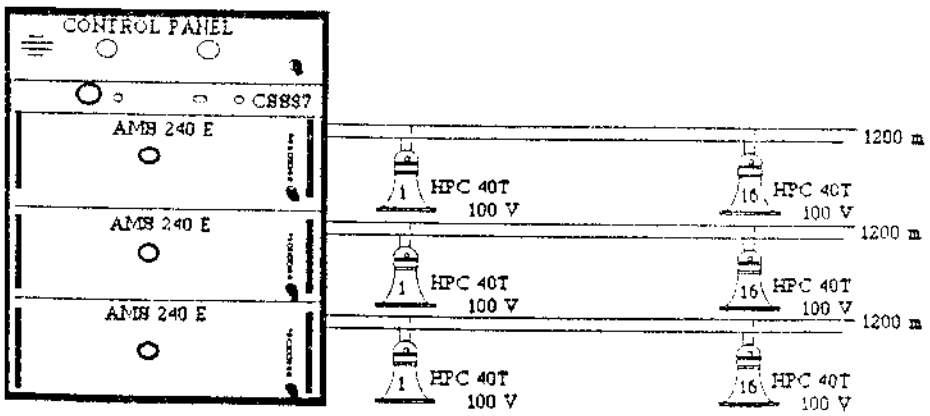


2. Method

- Draw near birds (100 meters) if possible in wind direction
- Stop your vehicle
- Indentify birds type (ex : Lapwings)
- Turn on the AMD 30 amplifier, the volume control being on position "max"
- Set sound selector switch on requested distress call (ex :Lapwings)
- Should you have any doubt about birds kind, use the interspecific position (N° 5)
- Turn on the CSS 87 M
- Use reset button "RAZ" in order to start the cycle
- Broadcast the sound for about 30 secs max.
- Should the birds fly above the car, fire dual detonation and crackle cartridges with shotguns and special pistols. Use hunting shotguns for species when authorized. If the birds fly in a different way, fire in their direction while emitting the signal.
- In order to avoid habit-forming, try the interspecific signal 1, or replace the digital sound by natural sound prerecorded on cassette to be played by TMK unit.

b) Bird strikes using central system

1. Required equipment : - Noise generator ref CSS 87 M (rack mounting type)
- N 240 W amplifiers ref AMS 240 E
- N Horn speakers ref HPC 40 T



2. Installation

- Number of requested amplifiers is proportional to runway length
- Two speakers should be fixed on top of 2 meters masts installed every 150 meters at 45 M from runway borders which means 16 speakers and 8 masts for a 1200M runway.
- Amplifiers and noise generator should be installed in a shelter as near as possible from runways.

OPTIONS : Failure detection system

The performance of the whole installation may be electronically supervised to indicate the following :

- Short circuit status (per runway)
- OPEN circuit status (per runway) and/or speakers open coil status (20 % accuracy e.g. 2 speakers out of 16 per runway)
- Amplifiers failure (per amplifier)

Upon detection of any mulfunction or failure the system will report the 3 faults information :

- Near the amplifiers location (one indicator per fault reported)
- To a central monitoring panel via one pair telephone cable using interface circuits allowing up to 32 different indications which means up to 10 runways with 3 faults.
- To a central monitoring panel via one pair telephone cable for each runway without any supplementary equipment but allowing only one indication for the 3 faults (separately or together)

3. Method

- Set sound selector switch on alternative alarm position (N° 7) in order to broadcast the signal every minute in high birds concentration period at sun rise and sun set.
- HAZARDOUS alarm (N° 8) may be used during low birds concentration periods
- CONTINUOUS alarm (N° 6) is provided to check speakers status and take measurements of sound level on runways by constant signal broadcasting
- SPECIFIC signals (gull, lapwings etc...) or interspecific 1 may be used three to five times a day during low traffic period in order to scare away birds staying behind speakers. Cut the alternative alarm (N° 7), broadcast the requested sound for about 30 seconds then go back to the initial alternative alarm position (N° 7).

6. TECHNICAL SPECIFICATIONS

Output level	+10 dB
DC power supply	12V-1A
Dimensions (WxHxD)	265x45x235 mm
Weight	1 Kg

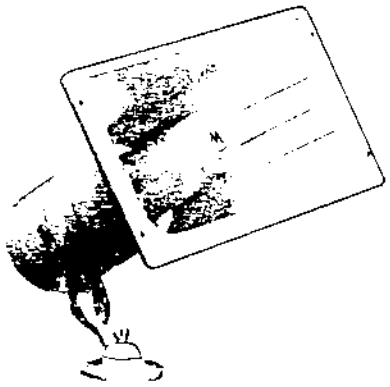
HAUT PARLEU
DE COMPRESS
HORN SPEAKE
PRESSURE CH

I Spécifications te

Puissance nominale *Nominal power*	
Puissance maximum *Maximum power*	
Entrées *Input*	
Pression acoustique *Sound pressure level*	
Bande passante *Bandwidth*	
Sélecteur de puissance *Power selector switch*	
Dimensions L × H × *Dimensions* W × H ×	
Materiaux *Material*	
Poids *Weight*	

Bobiné de rechange r
Spare coil ref. 4021

HAUT PARLEUR A CHAMBRE DE COMPRESSION *HORN SPEAKER WITH PRESSURE CHAMBER*	Sans transformateur *Without transformer*	HPC 40
	Avec transformateur TL 1845 *With transformer TL 1845*	HPC 40 T



— Pavillon rectangulaire en matière plastique moulée
— Socle de fixation orientable
— *Square type loudspeaker plastic moulded body*
— *Revolving mounting base*

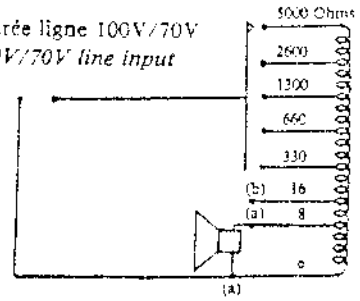
I Spécifications techniques / *Technical specifications*

	HPC 40	HPC 40 T
Puissance nominale *Nominal power*	32 W	32 W
Puissance maximum *Maximum power*	60 W	60 W
Entrées *Input*	8 Ohms	Ligne 100 V *100 V Line*
Pression acoustique *Sound pressure level*	107 dB/W/M	107 DB/W/M
Bande passante *Bandwidth*	450-7000 Hz	450-7000 Hz
Sélecteur de puissance *Power selector switch*	—	5 positions *5 steps*
Dimensions L × H × P *Dimensions W × H × D*	279 × 168 × 285	279 × 168 × 285
Materiaux *Material*	Plastique moulé	*Moulded plastic*
Poids *Weight*	2100 g	2600 g

Bobiné de rechange ref. 4021
Spare coil ref. 4021

merlaud
76, Boulevard Victor Hugo
B.P. 18-92114 CLICHY CEDEX
Tél.: (1) 47.37.75.14 - Telex MERLAUD 614600 F

II Connection / *Wiring*

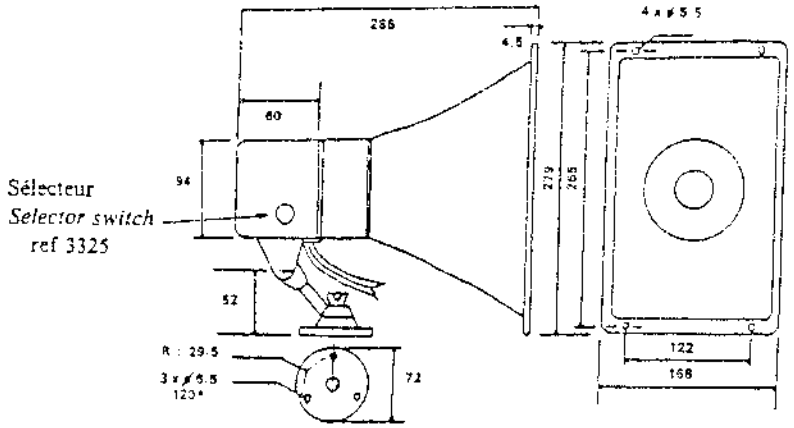


— Livré normalement branché pour ligne 100 V point (a),
— Pour utilisation en ligne 70 V, brancher le haut parleur au point (b).
— Pour utilisation en 8 Ohms, débrancher le transformateur (HPC 40).
— Pour utilisation en 16 Ohms, connecter le Haut parleur au point (a) et brancher l'entrée au point 16 Ohms (b).
— *Supplied for 100 V line operation point (a), in case of 70 line, connect speaker to (b) tap.*
— *For 8 Ohms use, disconnect transformer (HPC 40).*
— *For 16 Ohms use, connect the speaker to (a) tap, and connect input directly to 16 Ohms (b) tap.*

. HPC 40 T : Sélecteur 5 positions ref. 3329 / Transformateur TL 1845
5 Steps selector switch ref. 3329 / Transformer TL 1845

Connexion *Connexion*	Ligne / *Line*	BORNES TRANSFORMATEUR / *TRANSFORMER TAPS*		330	660	1300	2600	5000
(a) Normal	100 V	P (Watts) Z (Ohms)		30 330	15 660	7,5 1300	3,8 2600	1,9 5000
	70 V	P (Watts) Z (Ohms)		15 330	7,5 660	3,8 1300	1,9 2600	0,9 5000
(b) Option	70 V	P (Watts) Z (Ohms)		30 165	15 330	7,5 660	3,8 1300	1,9 2600
	100 V	Interdit / *not allowed*						

Dimensions / *Dimensions (mm)*



Notice technique n° 2115

AMPLI
De PU

SÉRIE EC

CARACTÉRISTIQUES

- Echelle de diodes lum
- Réglage du niveau gé
  la série E.
- Réglage du niveau gé
  des aigus pour série E
- Prises d'entrées norm
  rotillables rautres sur
- Façade alu anodisé
- Coffret metallique pe
- Standard 19 pouces
- Protection electroniq
  ges et les courts-circui
- Possibilité de l'équipe

- Disponible en tirage e
  tiomètre rotant à axe

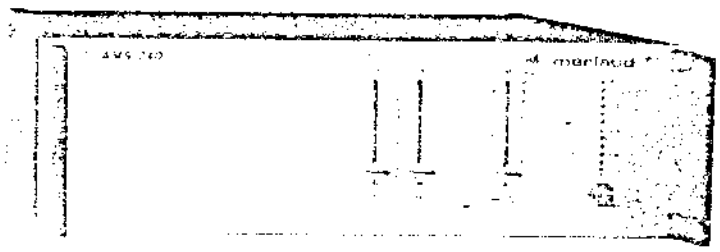
AMPLIFICATEURS De PUISSANCE Série E/EC

APPENDIX 3

POWER AMPLIFIERS E/EC Series

- E : sans contrôle de tonalité / without Tone control
- EC : avec contrôle de tonalité / with Tone control

SERIE EC



CARACTÉRISTIQUES GÉNÉRALES :

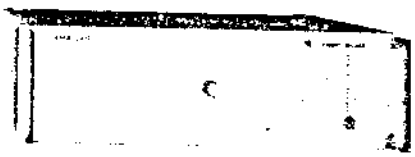
- Echelle de diodes lumineuses.
- Réglage du niveau général par potentiomètre rotatif pour la série E.
- Réglage du niveau général et réglage séparé des graves et des aigus pour série EC uniquement.
- Prises d'entrées normalisées DIN 5 broches 180° verrouillables (autres sur demande par quantités minimal).
- Façade alu anodisé
- Coffret métallique peint grain cuir noir.
- Standard 19 pouces 3U - Prévoir 2 equerres EQ 8140.
- Protection électronique et thermique contre les surcharges et les courts-circuits.
- Possibilité de l'équiper d'un PES sur demande.

- Disponible en tiroir embrochable 19 pouces avec potentiomètre rotatif à axe lendu (Série E uniquement)

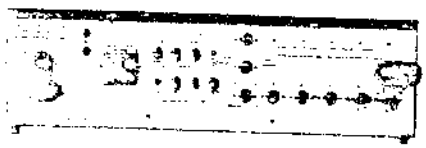
GENERAL SPECIFICATIONS

- Luminous led level indicators
- Rotary potentiometer general control level for E series.

- Sliding general volume control and separate treble and bass face control for EC series only.
- 5 Pins 180° Locking Din input sockets others on request per minimum quantities!
- Anodized aluminium front panel.
- Black granulated painted sheet steel body.
- 3 U-19 inch standard rack mounting – add 2 X EQ 8140.
- Overload and short circuit electronic and thermal protection.
- May be equiped with one PES preampler plug in PC board on request.
- Available in 19 inch plug in drawer type with knobless rotary potentiometer (E series only)



E SERIES
SÉRIE E



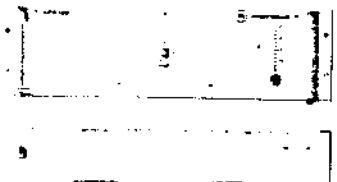
Rear Panel
Face arrière

merlaud
Constructions Électro - Acoustiques 76 Bd V. cor Hugo
B.P. 19 - 92114 - CLICHY - CEDEX
Tél. (1) 737.75.14
Télex. MERLAUD 614600F

Spécifications Techniques

Technical specifications

RMS Power (W) Puissance nominale de sortie (W)	50	75	120	120	240	50	75	120	120	240
Musical Power (W) Puissance musicale (W)	70	80	145	130	285	70	80	145	130	285
Peak Power (W) Puissance crête (W)	70	105	170	170	335	70	105	170	170	335
Peak to Peak Power (W) Puissance crête à crête (W)	140	210	340	340	670	140	210	340	340	670
Bandwidth Bande passante	40 / 15 000 Hz			40 / 10000 Hz		40 / 15 000 Hz			40 / 10000 Hz	40 / 15000 Hz
Harmonic Distortion Distorsion harmonique	0,5 % / 1 000 Hz			5 % / 1 000 Hz		0,5 % / 1 000 Hz			5 % / 1 000 Hz	0,5 % / 1 000 Hz
Signal to noise ratio Rapport signal bruit	75 dB	75 dB	75 dB	75 dB	75 dB	75 dB	79 dB	80 dB	80 dB	88 dB
Tone control : Bass Contrôle de tonalité : Graves	± 15 dB / 40 Hz									
Tone control : Treble Contrôle de tonalité : Aigus	± 15 dB - 15 000 Hz									
Sensitivity Sensibilité	180 mV	180 mV	180 mV	180 mV	250 mV	180 mV	200 mV	250 mV	250 mV	250 mV
Input Impedance : 47 K ohms Impédance d'entrée : 47 K ohms	TE 1243 for balanced input / TE 1243 pour entrée symetrique									
Power supply Alimentation secteur	110/220 V ~ 50/60 Hz ± 10 %									
Consumption Consommation	100 VA	130 VA	190 VA	190 VA	420 VA	100 VA	130 VA	190 VA	190 VA	420 VA
Battery Power Supply Alimentation batterie				24 V 9 A					24 V 9 A	
Electronic and thermal protection Protection électronique et thermique	Yes Oui	Yes Oui	Yes Oui	therm.	Yes Oui	Yes Oui	Yes Oui	Yes Oui	therm.	Yes Oui
Unbalanced Speaker Outputs Sorties H.P. dissymétriques	4-8-16	4-8-16	4-8-16	4-8	4-8	4-8-16	4-8-16	4-8-16	4-8	4-8
Balanced Speakers Outputs : Volts Sorties H.P. symétriques : Volts	50-70-100 V	50-70-100 V	50-70-100 V	100 V	50-70-100 V	50-70-100 V	50-70-100 V	50-70-100 V	100 V	50-70-100 V
Balanced Speaker Outputs : Ohms Sorties H.P. symétriques : Ohms	50-100-200	33-65-130	20-41-83	83	10-20-40	50-100-200	33-65-130	20-41-83	83	10-20-40
Dimentions (mm) Dimensions (mm)	440 X 132 X 375									
Weight (kg) Poids (kg)	14	16	19	19	22	14	16	19	19	22



19 inch Plug in Drawer type
Tiroir embrochable 19 pouces

— Possibilité d'avoir des puissances supérieures sur une seule ligne 100 V en couplant en série :
AMS 240 E + AMS 240 E = 480 W/100 V

— *Building up to larger power on single 100 V line by series slave amplifiers :*
AMS 240 E + AMS 240 E = 480 W/100 V.

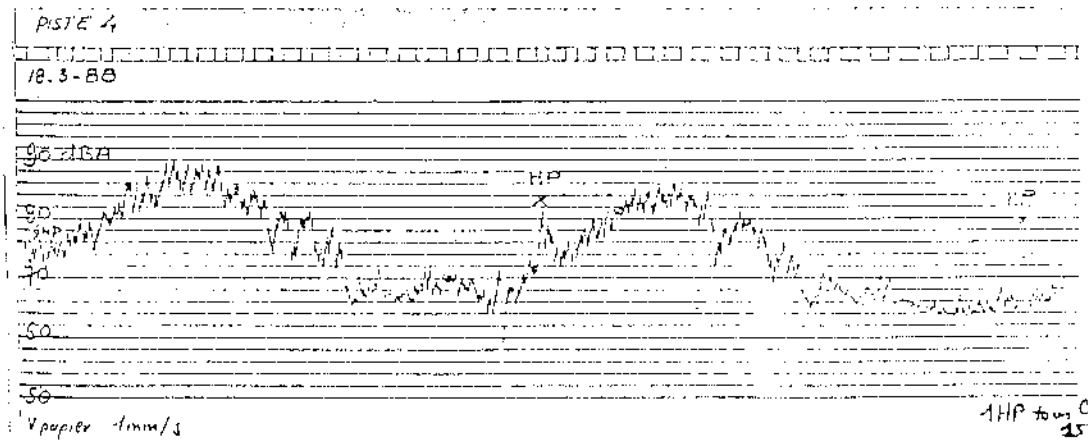
PORT DE · PARIS

OIRATOIRE

AXE DE PISTE

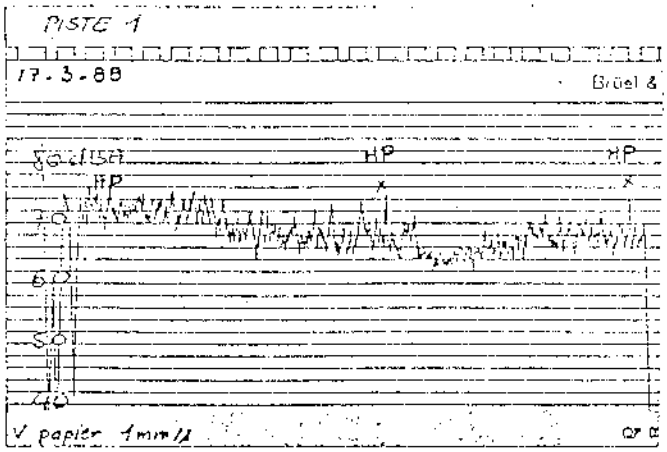
APPENDIX 7

Vent : 80° 4 Kts



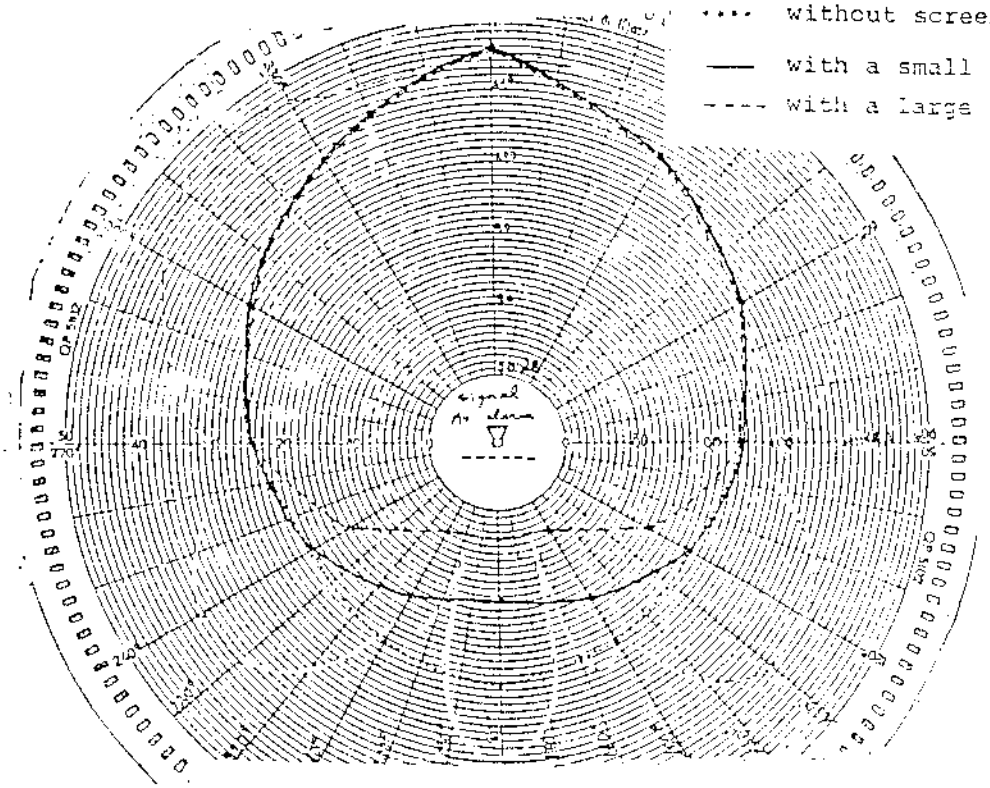
1 HP tour à 150 m
h = 2,5 m

Vent : 60° 5 Kts



1 HP tour à 40 m
à 20 m du bord de piste
h = 0,3 m

APPENDIX 8



HPC 40T MR HPC40T MERLAUD GRADIENT SPEAKER

Engine
Test M

(J.P. Devaux