

## GAZ-EX AVALANCHE CONTROL SYSTEM

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Since 1973, my company has been manufacturing and installing avalanche control equipments. Our 150 CA.T.EX (the "Bomb-Tram") with traditional explosives has been used with good success on three continents.

However, to avoid some of the drawbacks associated with more traditional methods (sometimes it was necessary to cut trees or dig trenches in environmentally sensitive areas to install the cable and towers ; during snow storms, explosives sometimes hung up on the towers, or ice was formed on the cable, causing derailment ; access to the power station was often dangerous and time consuming), I wanted to develop a system that would allow explosives to be stored all through the winter at the avalanche control device site. Additionally, I wanted a system that would work effectively with remote controls, that could be operated safely and easily accessed from a road or railway, from power stations, from the center of a resort area, etc.

I had the idea of using a metal tube with the power generated by ignition at the base of the tube and exploding gas out of the open end. We tested many possibilities on the mountains in the snow. We measured air pressures resulting from the gas explosions (with CEMAGREF assistance) and experimented with many different gases and combinations. A mixture of propane and oxygen finally appeared to be the most efficient.

The test results and our operational experience clearly confirm that the shock wave resulting from a GAZ-EX explosion is longer than an explosive detonation shock wave, giving much better avalanche control :

- just 1 Kg of gas is needed to produce the same shock wave as 8 Kg of TNT (about 25 mb)
- a single 1.5 cubic meter GAZ-EX Installation, at 7500 ft elevation, is equivalent to 15 Kg of TNT !

An operational GAZ-EX system is made up of the following components :

- A shelter installed to protect the following equipment : an oxygen reserve and a propane gas reserve brought during good weather, release tanks for the oxygen and propane, pressure gauge for the oxygen, electrovalves, electrically operated controls for the valves and the firing systems, using either a radio remote control system or a direct wired key system.
- In addition, the system includes one or more exploders (depending on the site) with their firing systems, and a gas line consisting of two tubes (one for oxygen, the other for propane) between the release tanks in the shelter and the exploder(s).

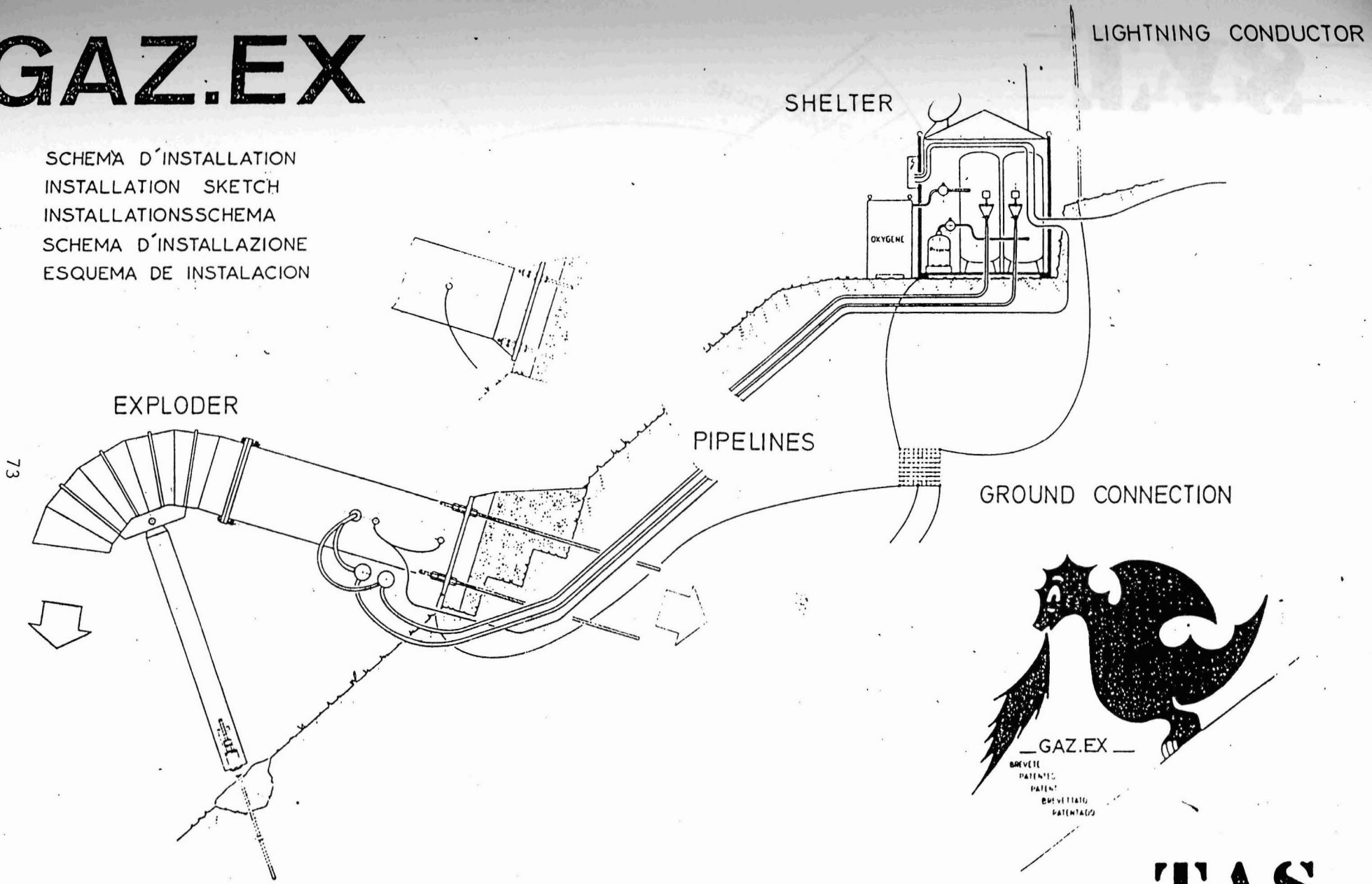
The firing is controlled by opening the valves for the oxygen and propane of predetermined and accurate levels. Gas from the release tanks goes through the tubes of the exploder. The valves are closed and the gas mixture is ignited, using an electric arc between two electrodes, setting off the gas explosion.

Thanks to its efficient design, the GAZ-EX equipment performs easily and well, through the planned release of successive small avalanches, whatever the weather. GAZ-EX provides a highly efficient method of protecting roads and rails, ski lifts, electric towers, homes and buildings that may not resist the force of a natural avalanche.

Since 1988, 135 GAZ-EX exploders have been manufacturing and installing on three continents, including 24 ones in the U.S.A.

# GAZ.EX

SCHEMA D'INSTALLATION  
INSTALLATION SKETCH  
INSTALLATIONSSCHEMA  
SCHEMA D'INSTALLAZIONE  
ESQUEMA DE INSTALACION



TAS

5 kg EXPLOSIVE

DETONATION ZONE  
6000 m/s

Shock-wave zone  
332 m/s

EXPANSION  
ZONE

1,5 cu.m  
GAZEX

DETONATION ZONE  
INCLUDING THE INSIDE  
OF THE EXPLODER  
3000 m/s

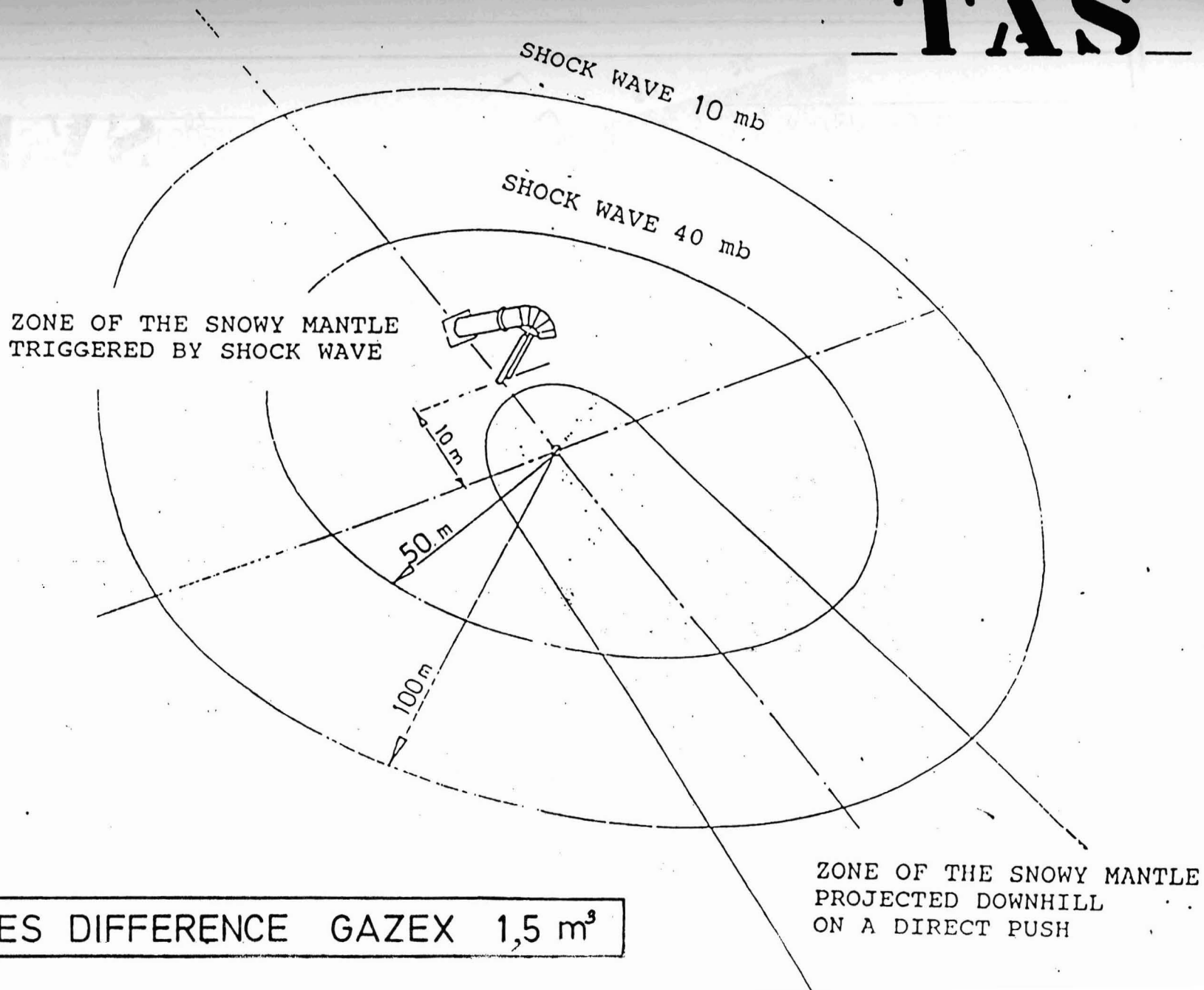
Shock-wave zone  
332 m/s

COMPARISON OF EXPLOSIVE  
SHOCK WAVE AND GAZEX

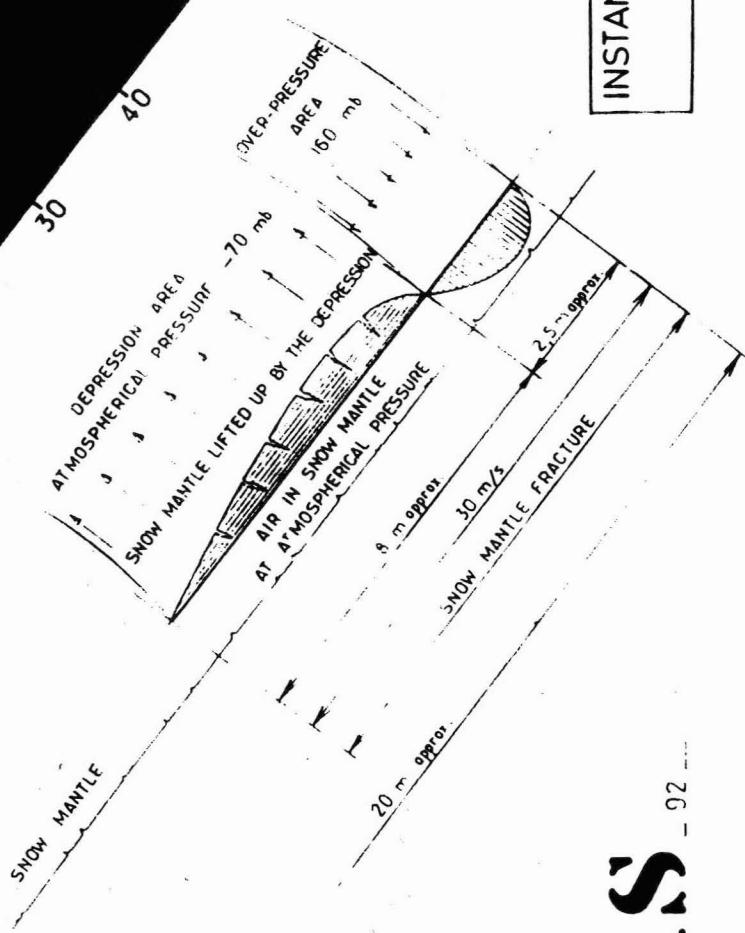
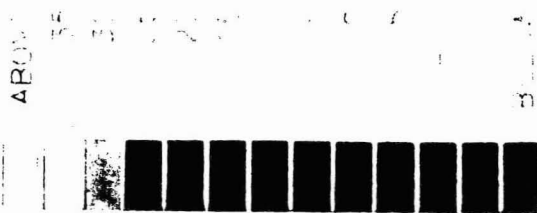
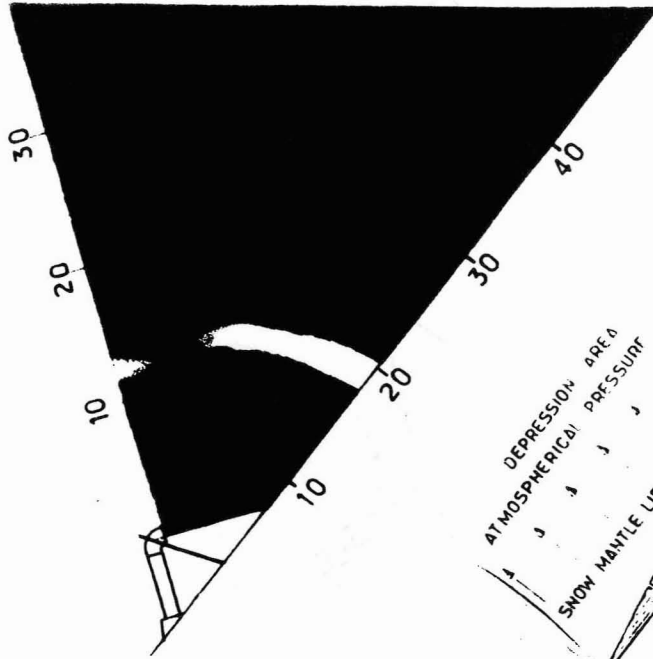
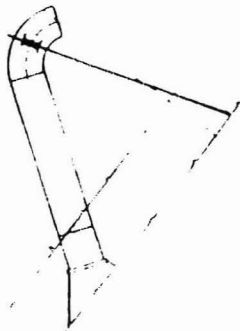
1,5 cu.m = 1,8 kg of gaz  
a 2 500 m  
> 12 kg Explosive

TAS

74



1,5 Cu.m EXPLODER

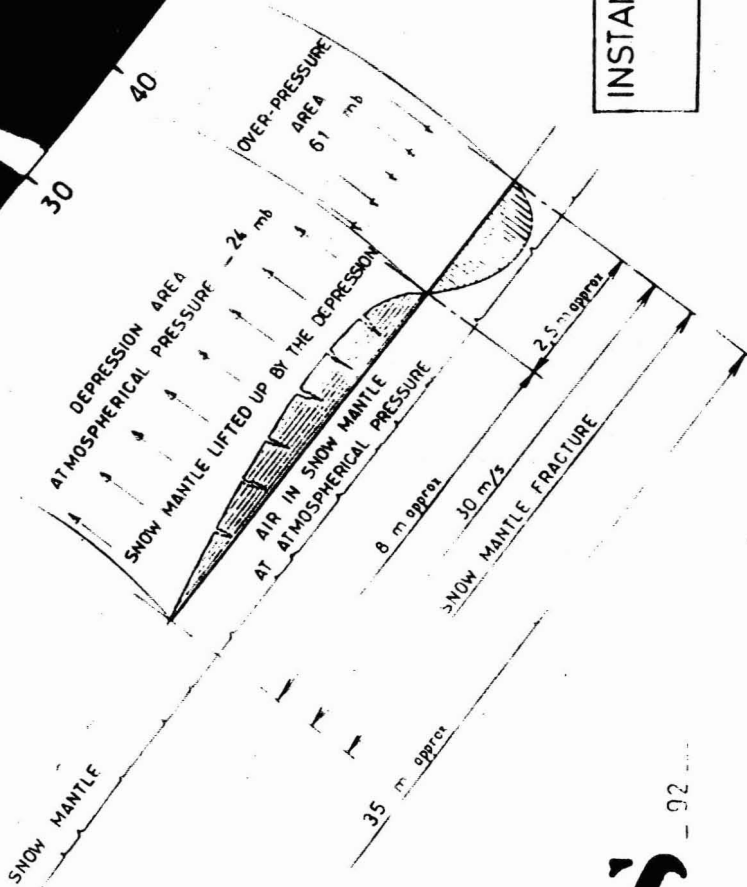
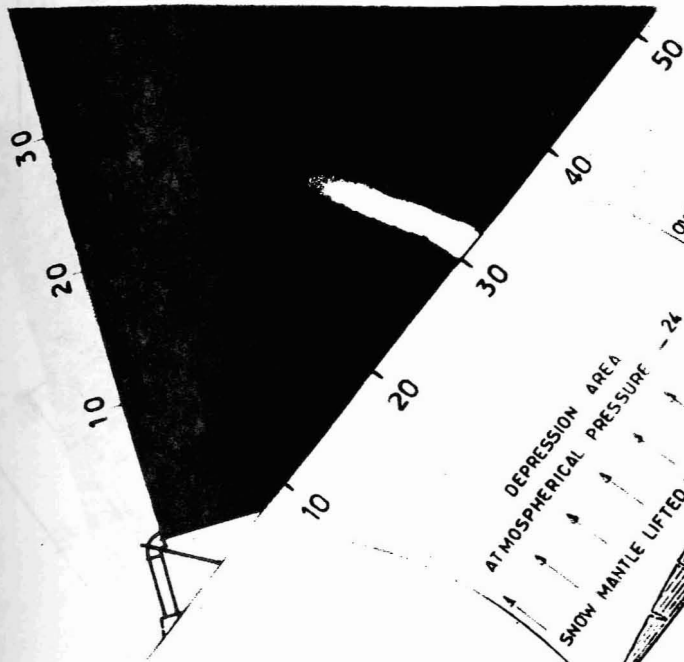
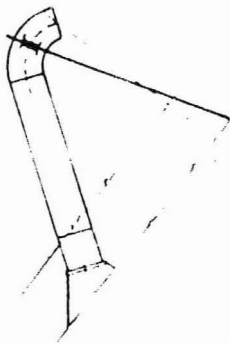


INSTANTANEOUS PRESSURES  
AFTER 30 m/s

TAS

Sept. 92

1,5 Cu.m EXPLORER

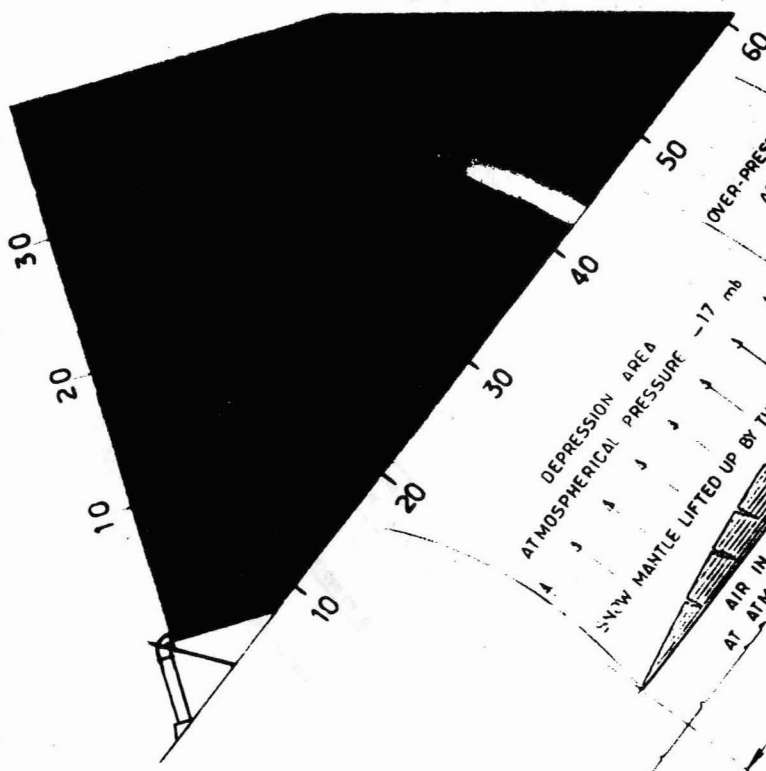
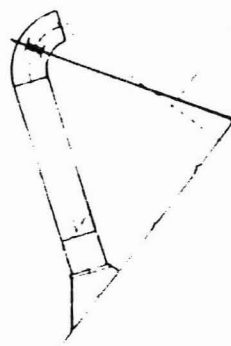


INSTANTANEOUS PRESSURES  
AFTER 60 m/s

TAS

Sept. 92

1,5 Cu.m EXPLODER



480

BELOW

INSTANTANEOUS PRESSURES  
AFTER 90 m/s

SNOW MANTLE

DEPRESSION AREA  
ATMOSPHERICAL PRESSURE -17 mb

OVER-PRESSURE  
AREA 37 mb

SNOW MANTLE LIFTED UP BY THE DEPRESSION  
AIR IN SNOW MANTLE  
AT ATMOSPHERICAL PRESSURE

8 m approx

30 m/s

SNOW MANTLE FRACTURE

2,5 m approx

45 m approx

TAS

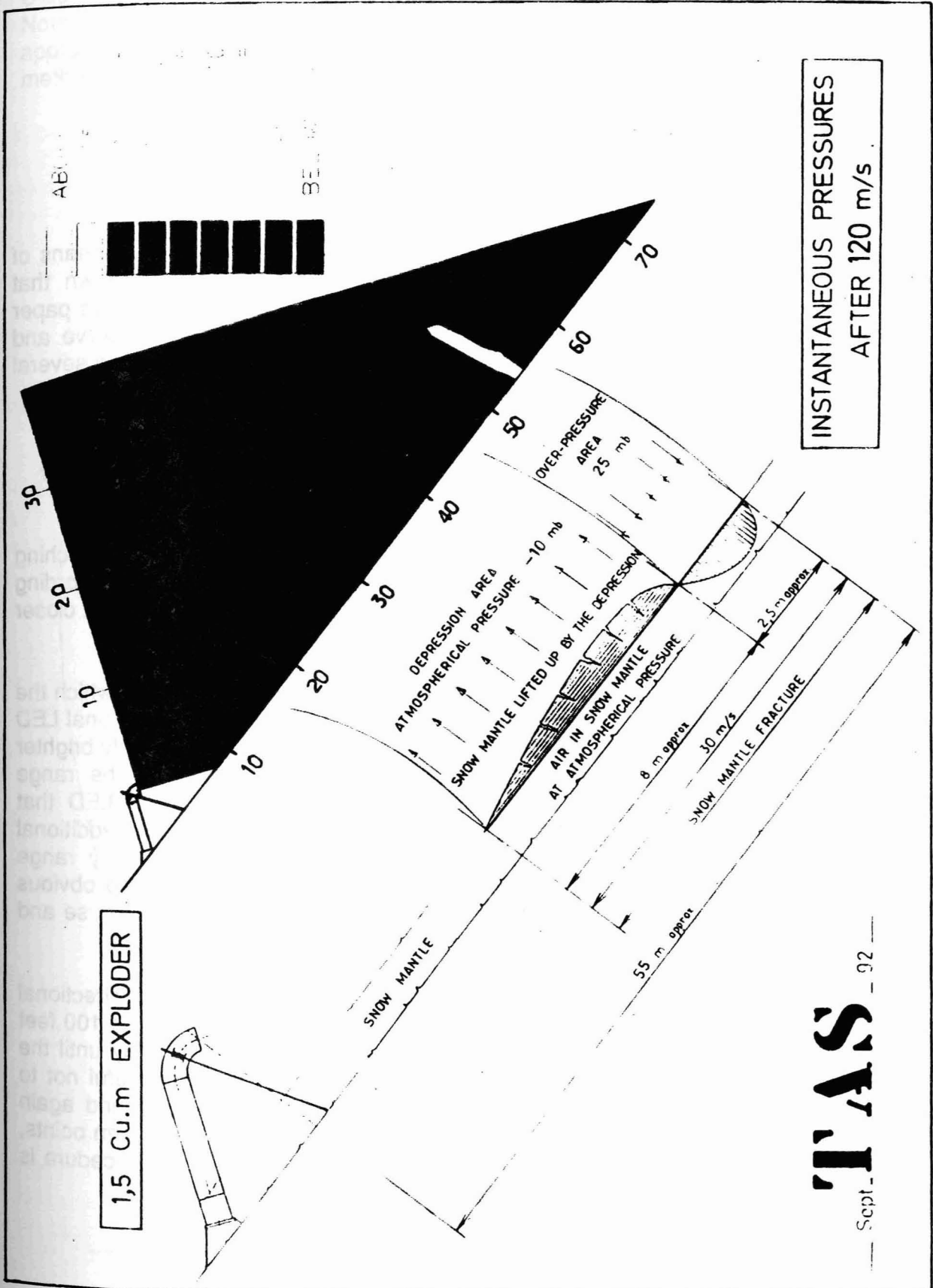
Sept. - 92

AB

BE

1,5 Cu.m EXPLODER

INSTANTANEOUS PRESSURES  
AFTER 120 m/s



TAS

Sept. - 92