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INNOVATIVE DEVELOPMENTS AT THE NTS REVERBERANT CHAMBER

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Acoustic Testing

- **REVERBERATION** : Performed in a “Reverb” Chamber using reflective sound in a uniform field. Typical Overall Sound Pressure Levels (OASPL) 120-160dB.
- **PROGRESSIVE** : Performed in a Progressive Wave Tube (PWT) using a directional sound source. Typical OASPL 155-175dB.



Acoustic Chambers



Chambers 90 cu.ft. - 5000 cu.ft

Large Chamber - 21'H x 15'D x 17'W

Frequency Range of 16 to 20,000 HZ

OSSG's augment the spectrum from
500 to 80,000HZ



Clean Preparation Room

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Progressive Wave Tube (PWT)

4' X 4' X 1' Test Area



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NAME	LOCATION	VOLUME (cubic feet)	VOLUME (cubic meters)	OASPL (dB)
NASA, JOHNSON SPACE CENTER	HOUSTON, TEXAS	12,160	344	166
NATIONAL TECHNICAL SYSTEMS	SAUGUS, CALIFORNIA	5,000	142	>165*
NASA, JOHNSON SPACE CENTER	HOUSTON, TEXAS	57,131	1,617	165
MARSHALL SPACE FLIGHT CENTER	HUNTSVILLE, ALABAMA	5,000	142	164
TSAGI, RK-1500	REPUBLIC OF KOREA	57,563	1,630	164
EAST-WEST TECHNOLOGY LAB	WEST PALM BEACH, FLA	166	4.7	163
NASA, JOHNSON SPACE CENTER	HOUSTON, TEXAS	133,950	3,793	162
JET PROPULSION LABORATORY	PASADENA, CALIFORNIA	10,900	309	157
LARGE EUROPEAN ACOUSTIC FACILITY (LEAF)	NOORDWIJK, NETHERLANDS	57,400	1,624	155**
INSTITUTE OF AEROSPACE RESEARCH	OTTAWA, CANADA	18,929	536	155
BOEING	HUNTINGTON BEACH, CA	6,728	190	155
NATIONAL SPACE PROGRAM OFFICE	TAIWAN R.O.C.	8,949	262.5	152
TSUKUBU SPACE CENTER	TSUKUBU, JAPAN	56,503	1,607	151
NASA, GODDARD SPACE FLIGHT CENTER	GREENBELT, MARYLAND	37,066	1,050	150
BOEING	SEAL BEACH, CA	25,800	730	150
ISVR	SOUTHAMPTON UNITED KINGDOM	12,290	348	147
LANGLEY RESEARCH CENTER	VIRGINIA	9,817	278	145

Need for Innovation

- Non-Standard Acoustic Spectrums evolving from new technology.
- Challenging Test Item Set-up or Operation during Acoustic Exposure.
- Combined Environments with Acoustics: Temperature / Vibration / Flow



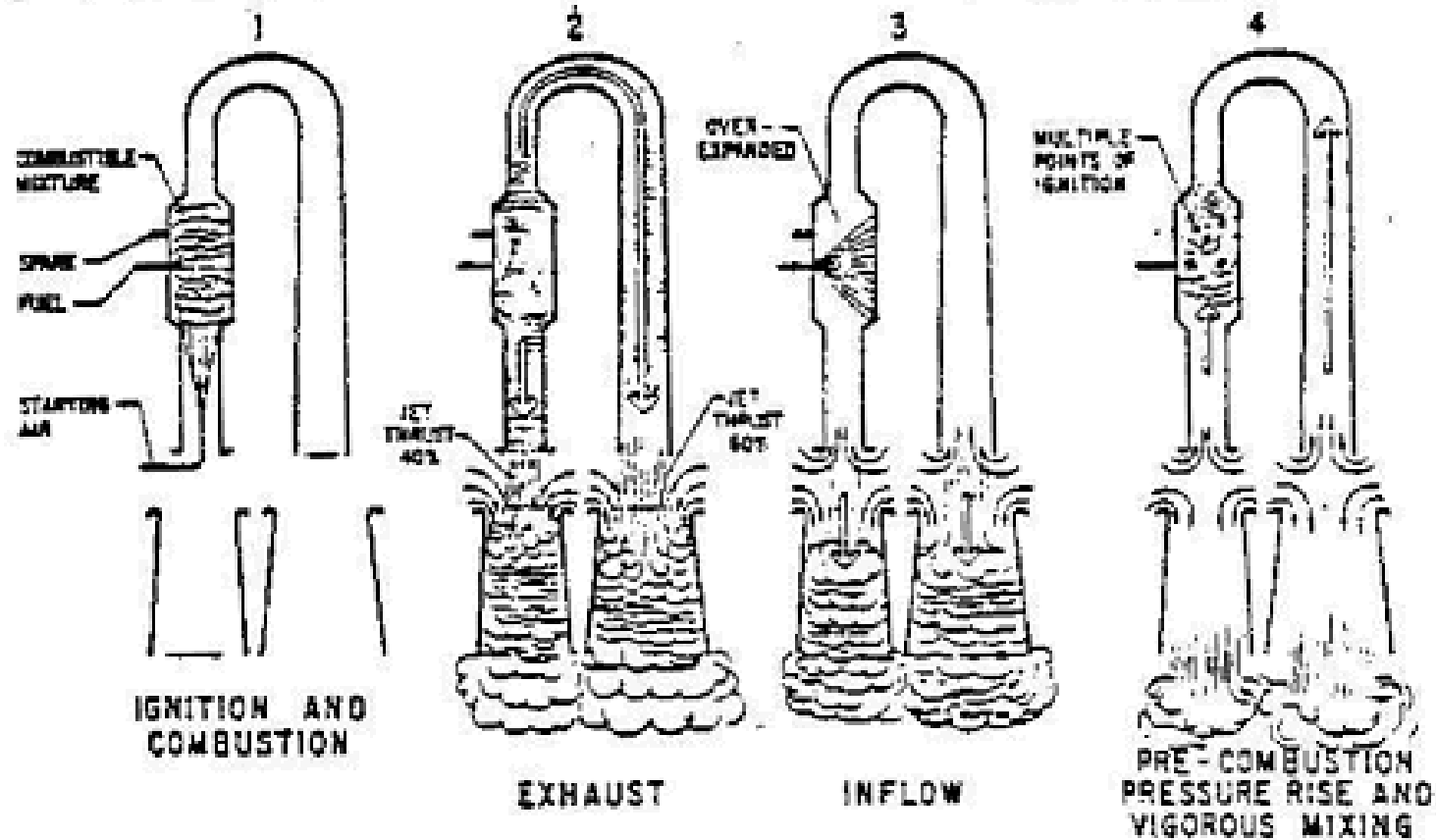
Innovations for Non-Standard Acoustic Spectrums

- Variety of Modulators to enhance different frequency ranges:
 - Team - Mark VI, Mark VI.2
 - Ling - 94B, 1094, EPT 200
 - Wyle - WAS 3000
- NTS Patented OSSG to supplement high frequency (1-10KHz).
- Pulse Detonating Engine to supplement low frequency (5-60Hz).



Valve-less Pulse Jet Operation

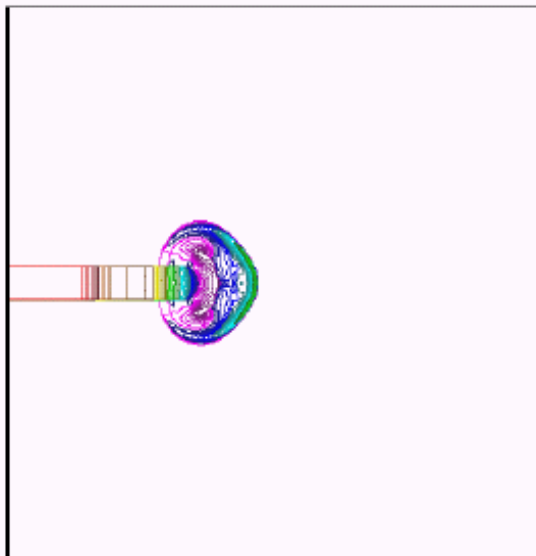
PULSE-JET CYCLE DIAGRAM



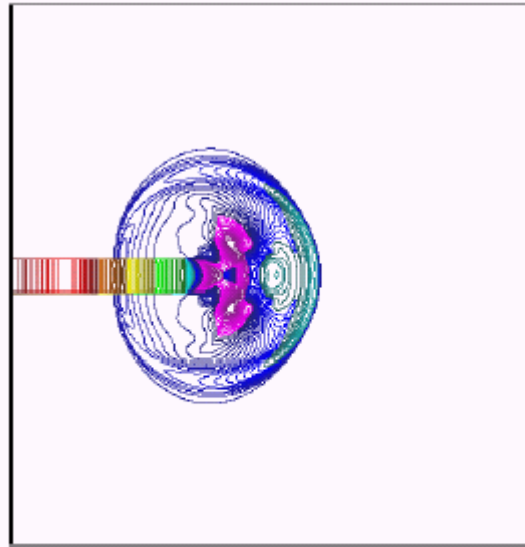
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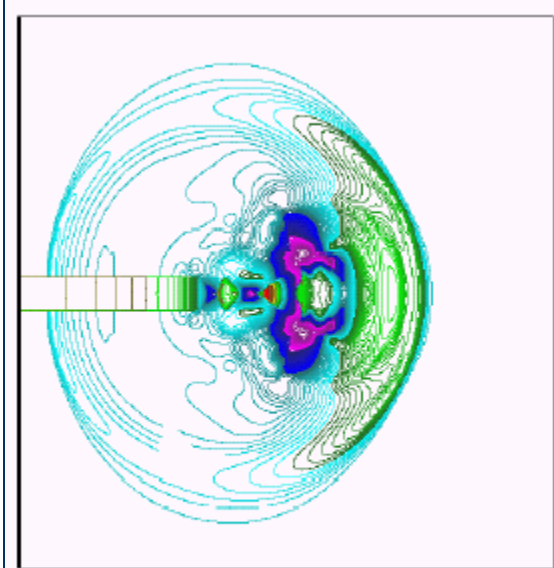
Three Snapshots of Pressure Contours of a PDE Plume



(a) $t = 0.642 \text{ ms}$

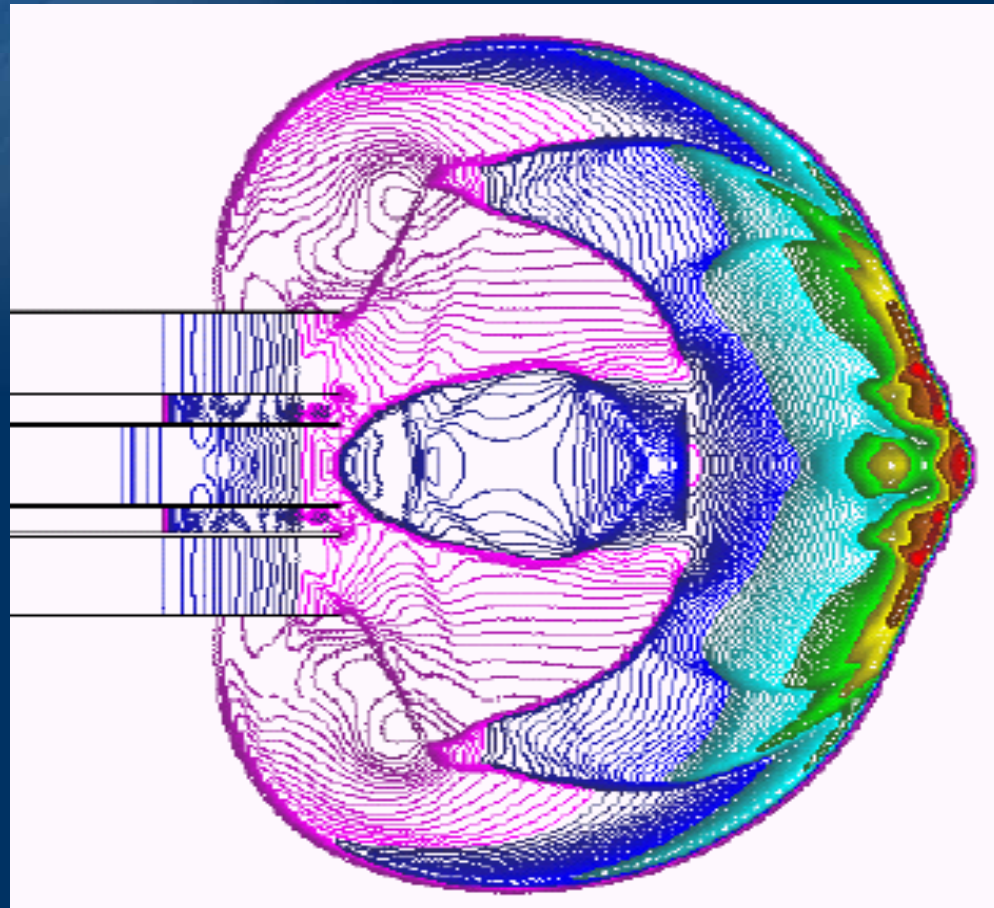


(b) $t = 1.124 \text{ ms}$



(c) $t = 1.927 \text{ ms}$

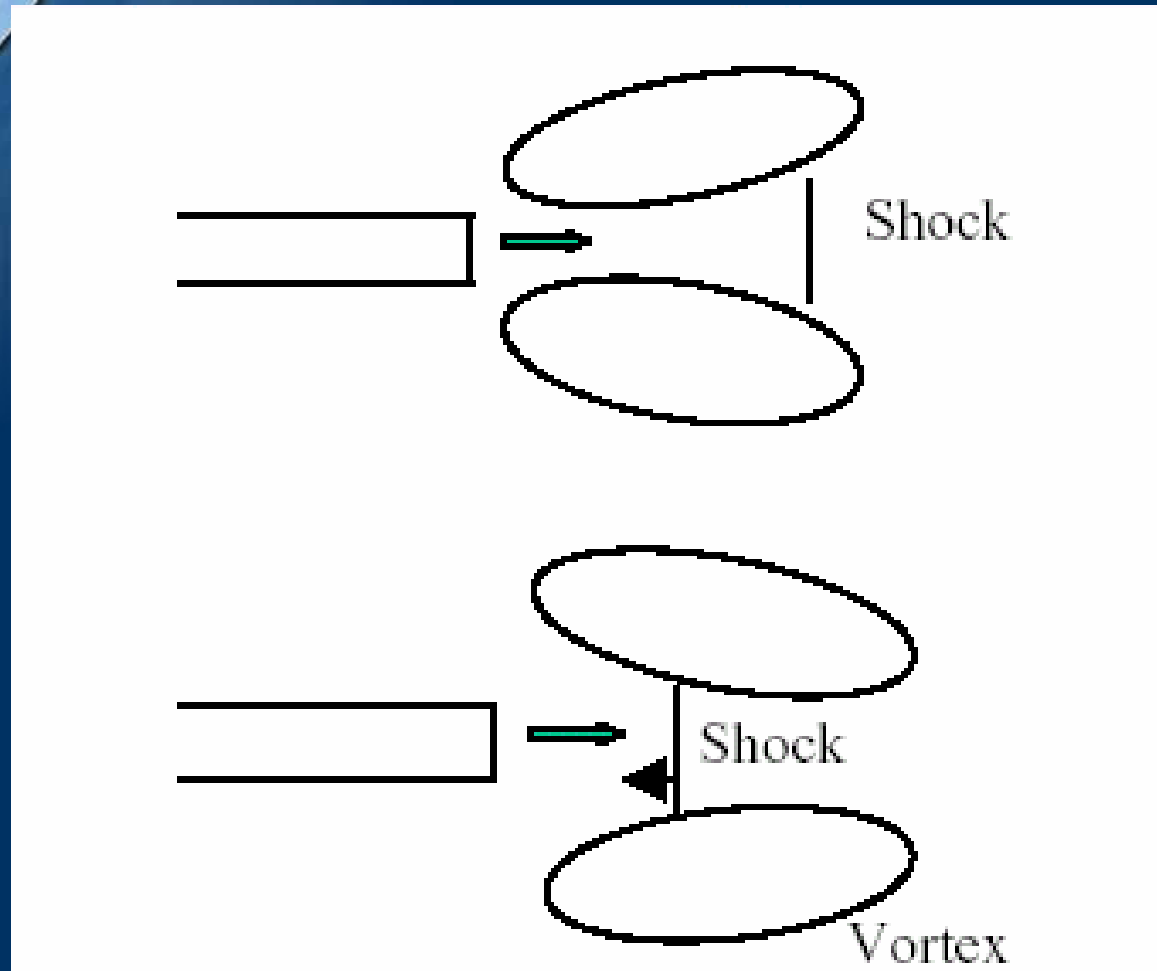
Pressure Contours of a Three-Tube PDE



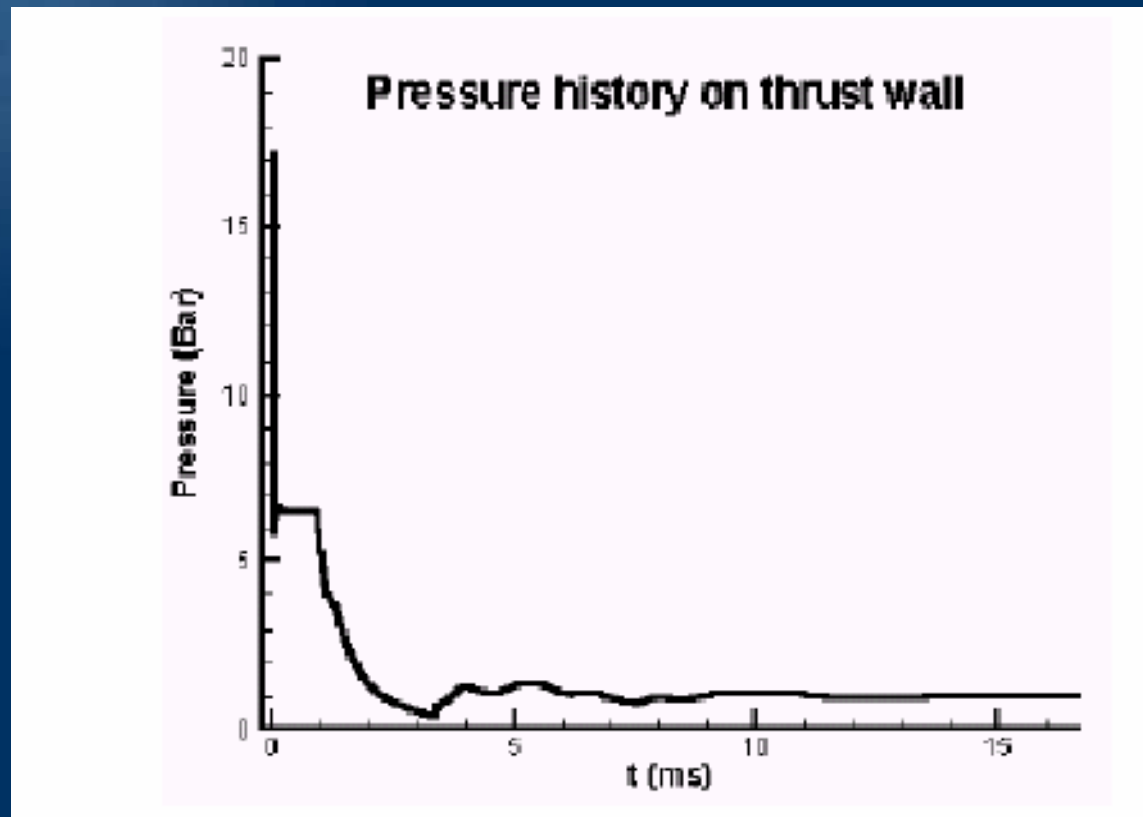
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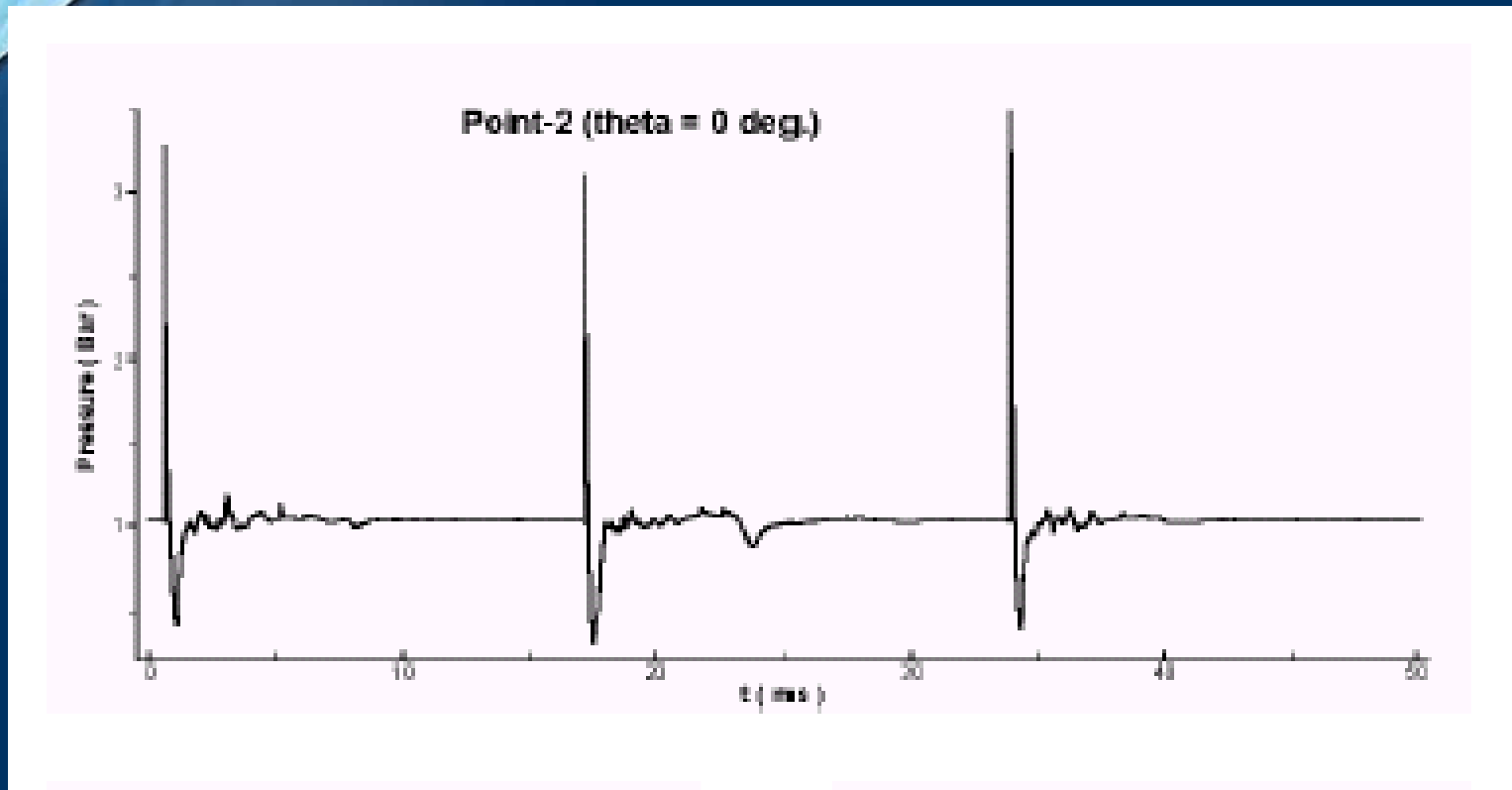
Vortex / Shock Interactions in the Near Field



Time History of Pressure at the closed end of Air Thrust Tube



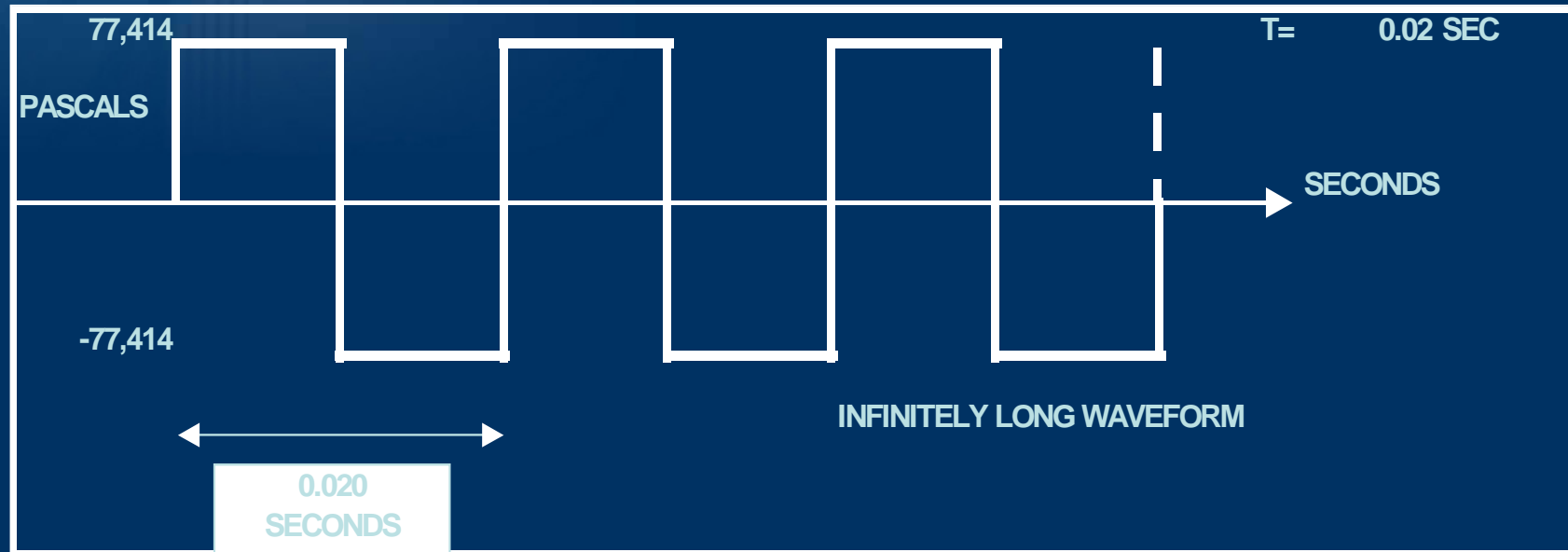
Three-Cycle Time History of Pressure at 5.66 inches Downstream



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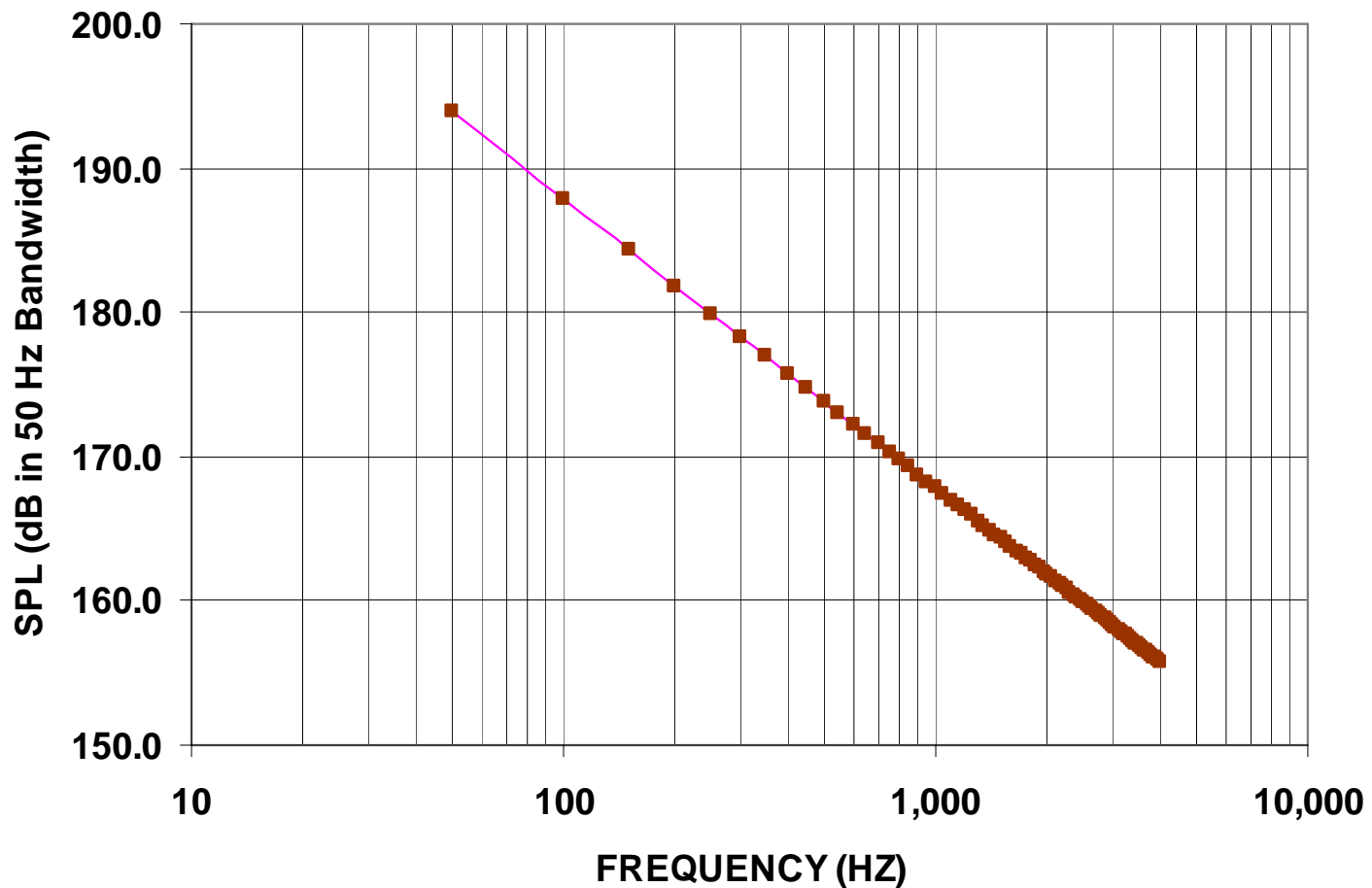
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Square Waveform Pressure History



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Sound Pressure Level for PDE at Duct Exit



Challenge Inspires Innovation

- Non-Standard Test Requirements usually leads to new Developments in Test Methods and Techniques.
- Combining Standard Modulators with OSSG and/or PDE can make some Unusual or even Impossible Test Spectrums feasible.

