



---

***REDUCING TARGET  
DISPERSION FOR HIGH MASS  
AND LOW VELOCITY  
PROJECTILES***

**Ted Haeselich**

**NICO Pyrotechnik  
22946 Tritttau,  
GERMANY**

**Roy Kelly**

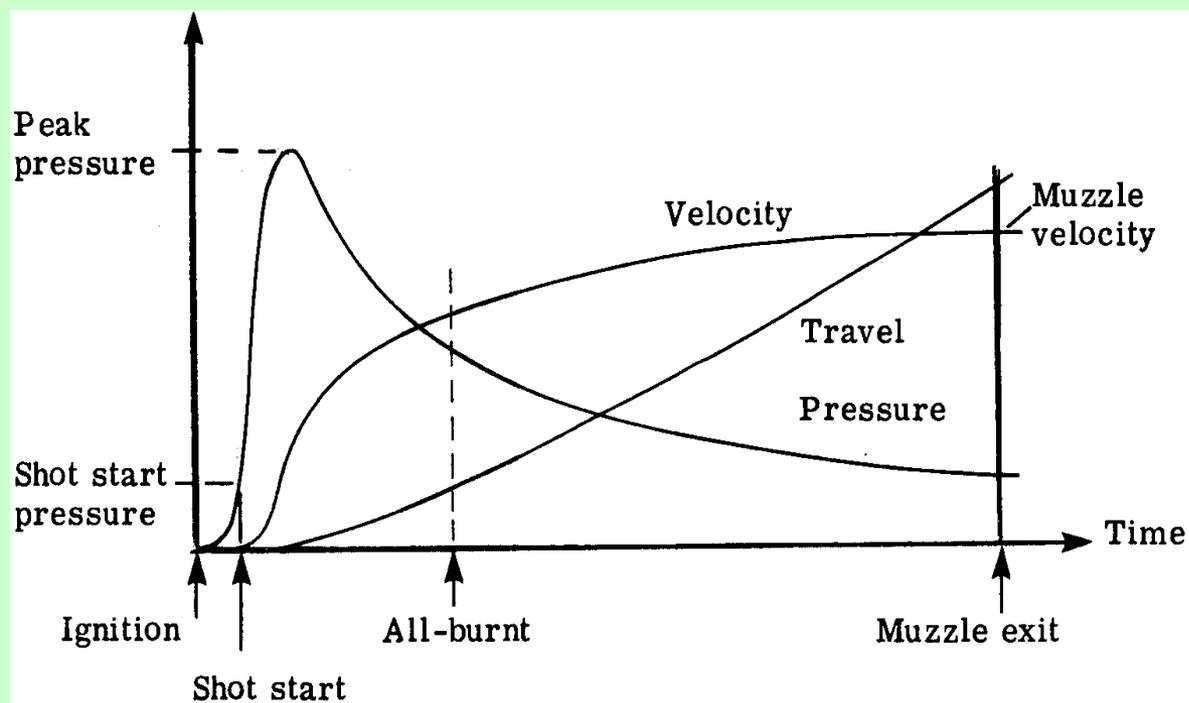
**Delta Defense, Inc.  
1111 Jefferson Davis Hwy  
Suite 508  
Arlington, Virginia 22202**

***NDIA 2002 International Infantry & Small Arms Symposium  
Session X - Small Arms Technology & Systems***

## ***IDEAL INTERNAL BALLISTICS FOR GUN FIRED ORDNANCE***

- **Modern single and double based propellants work best at high pressures to ensure complete combustion of the powder soon after the projectile moves (shot start)**
- **This ensures reproducible muzzle velocities independent of crimping force and only slightly dependent on ambient temperature**

# IDEAL PRESSURE/TIME, TRAVEL/TIME & VELOCITY/TIME CURVES



The ideal system works best at high velocities and high pressures

## ***NON-IDEAL INTERNAL BALLISTICS***

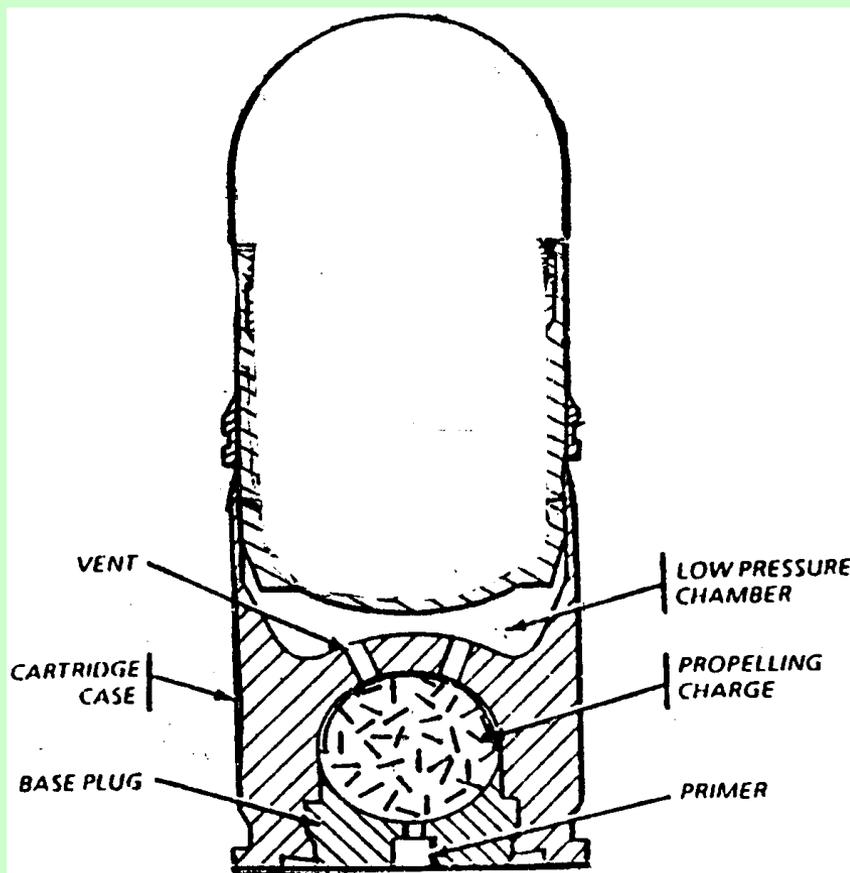
- **For low velocities and low pressures there is little resistance to projectile travel. The propellant burns into an increasing volume which restricts the rise in pressure and limits the increase in burning rate.**
- **As a consequence, not all propellant is burnt at shot exit leading to erratic muzzle velocities and high target dispersion**
- **In this situation, muzzle velocities and target dispersion become very dependent on ambient temperature**

## ***PRINCIPLE OF HIGH-LOW PRESSURE PROPULSION SYSTEMS***

- **Separate high and low pressure chambers are adopted in some systems such as 40mm cartridges**
- **This ensures that the propellant burns at high pressure until a copper disc is ruptured between the high and low pressure chambers**
- **Even so, all the powder may not be burnt before shot exit, particularly at low ambient temperatures**

## STANDARD US CARTRIDGE CASE DESIGN FOR 40MM HIGH VELOCITY PROJECTILES

- **M430 (HEDP)**
- **M385 (Inert Slug)**
- **M918 (Flash/Bang)**



---

## ***PRINCIPLE OF NICO HIGH-LOW PRESSURE PROPULSION SYSTEM***

- **The cartridge case is screwed to the projectile during assembly**
- **Shot start occurs when sufficient pressure is reached in the low pressure chamber to rupture the connection between the cartridge case and the projectile**
- **This occurs at a pre-determined break point at the base of the screw connection between the projectile and its case**

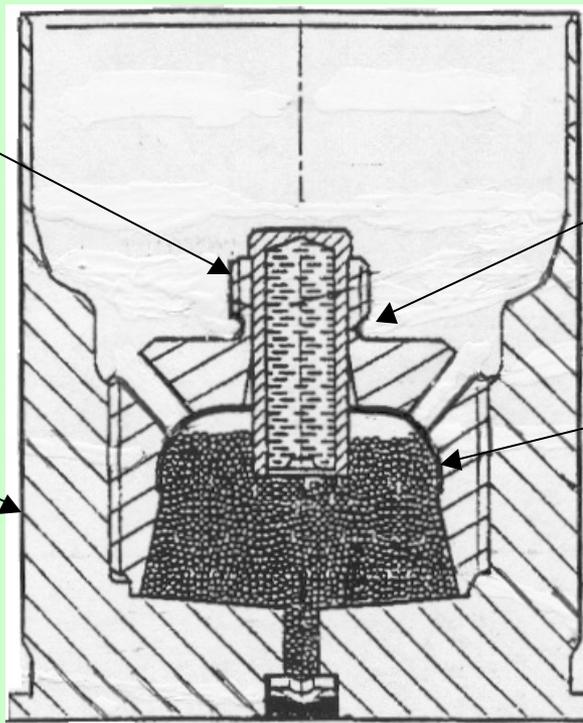
# NICO PROPUSION SYSTEM DESIGN FOR 40MM HIGH VELOCITY PROJECTILES

connecting thread

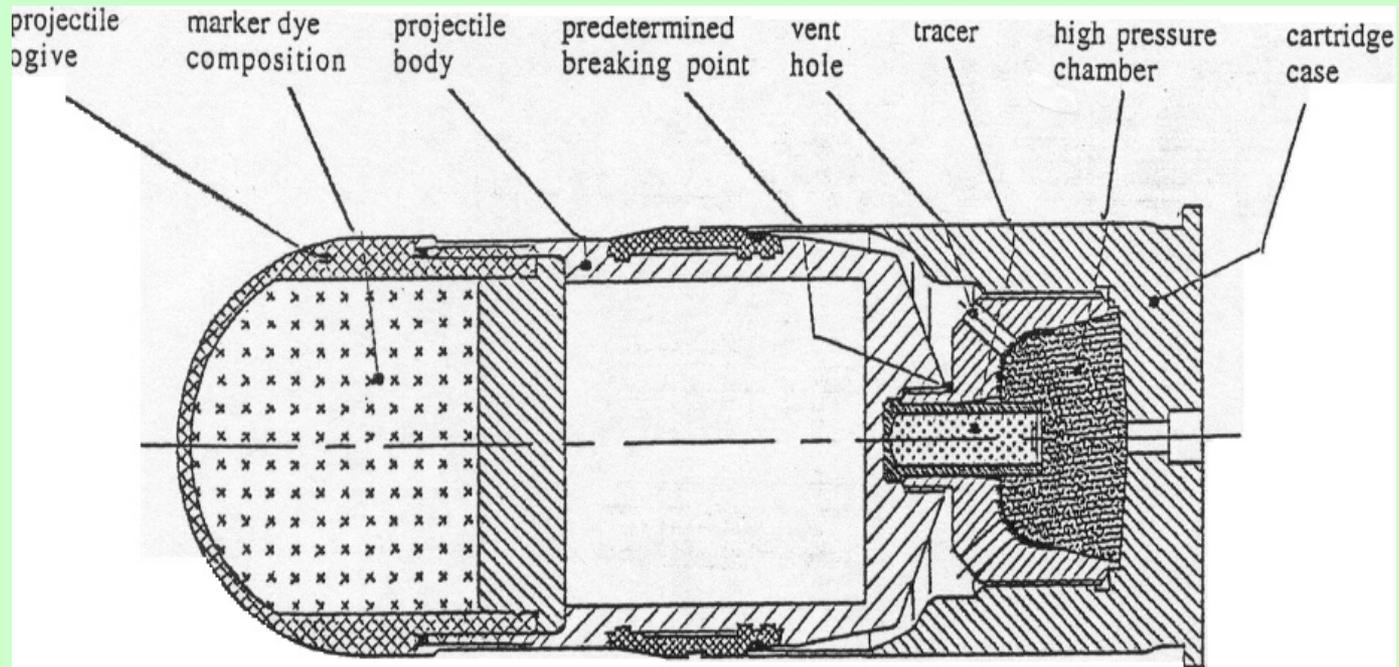
pre-determined  
break point

one piece  
cartridge case

high pressure  
chamber



# TYPICAL NICO CARTRIDGE FOR 40MM HIGH VELOCITY PROJECTILES



**40mm x 53 Practice Cartridge with Impact Signature and Tracer**

## ***ADVANTAGES OF NICO CARTRIDGE CASE DESIGN***

- **Dispersion is reduced because the propellant burns faster at the higher pressure and is all consumed before shot exit**
- **The one piece cartridge case removes the need for a separate base plug**
- **The design permits the use of a tracer**

## **40mm MOPI REQUIREMENT TESTING AT MEPPEN**

				<b>SD of Dispersion at 300m</b>	<b>SD of Dispersion at 300m</b>
<b>Cartridge type</b>	<b>Temp (C)</b>	<b>Vo (mps)</b>	<b>SD (mps)</b>	<b>Width (m)</b>	<b>Height (m)</b>
<b>NICO 40mm</b>	<b>+21</b>	<b>240.4</b>	<b>2.3</b>	<b>0.52</b>	<b>0.31</b>
<b>NICO 40mm</b>	<b>+52</b>	<b>241.8</b>	<b>2.4</b>	<b>0.63</b>	<b>0.37</b>
<b>NICO 40mm</b>	<b>-35</b>	<b>238.5</b>	<b>2.5</b>	<b>0.74</b>	<b>0.45</b>
<b>M430</b>	<b>+21</b>	<b>242.5</b>	<b>2.9</b>	<b>0.82</b>	<b>0.61</b>
<b>M430</b>	<b>+52</b>	<b>246.8</b>	<b>3.4</b>	<b>1.05</b>	<b>0.83</b>
<b>M430</b>	<b>-35</b>	<b>227.6</b>	<b>4.8</b>	<b>1.64</b>	<b>1.04</b>

## ***SUMMARY***

- **The NICO propulsion system design reduces projectile dispersion on the target**
- **A family of 40mm cartridges (Practice, CS, OC, Flash/Bang) has been designed around the NICO propulsion system**
- **NICO's propulsion system has been adopted in 40mm air-bursting programmable ammunition for USSOCOM's Advanced Lightweight Grenade Launcher (ALGL) program**