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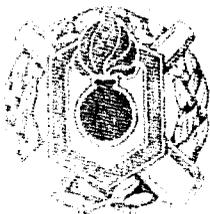
Technical Report ARAED-TR-88031

EFFECT OF TNT MISCIBLE ADDITIVES ON THE MECHANICAL BEHAVIOR AND SHOCK SENSITIVITY OF COMPOSITION B

Rodolf W. Velicky

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Armament Engineering Directorate

Picatinny Arsenal, New Jersey

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19. ABSTRACT (CONTINUE ON REVERSE IF NECESSARY AND IDENTIFY BY BLOCK NUMBER) TNT miscible additives are expected to desensitize Composition B to thermal and shock initiation by filling the microvoids (porosity) developed during casting by TNT's liquid or solid volume differential. Evaluation of this concept pointed out that the effect these additives have on the explosive's mechanical response to stress may increase its vulnerability to ignition through adiabatic compression. The wax in regular Composition B appears to develop a mechanical behavior in its crushed material similar to that caused by substituting TNT miscible additives and, therefore, is suspected of being responsible for inbore explosions through the adiabatic compression mechanism. Experimental procedures are described which should be able to test the validity of these suspicions. In addition, an approach is described which would improve the safety of RDX and TNT castings by controlling reaction rate during simple burning, and reducing its sensitivity to initiation by shock without the use of additives.			
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BACKGROUND

The improvement of Composition B is focused on eliminating its potential for setback induced inbore explosions in large caliber gun systems. The approach being followed is to provide an improvement at each of four steps (flaws, mechanical properties, ignitability, and reaction rate) in order to reduce the probability of the incident progressing through the sequence of events that would lead to an accident (refs 1 and 2). Success in this endeavor would make a Composition B type formulation acceptable in new high performance projectiles in addition to reducing its vulnerability to many other hazard situations.

An important part of this program is to modify the physical properties of Composition B in such a manner that its mechanical response (during launch) to a flaw induced collapse, fracture, or shear would be less likely to stimulate ignitions that result in inbore explosions. It has been demonstrated that Composition B's ability to resist fracture can be increased by a factor of three (refs 1 and 2). However, the work of Machacek et al. (ref 3) suggests that making the explosive maleable with TNT miscible chlorowaxes is an approach that should also be considered.

APPROACH AND OBJECTIVE

It is presumed that inbore explosions require a flaw of sufficient magnitude at or near the base of a projectile that, because of the explosive's mechanical properties, permit sudden deformation of the structure in response to inertial setback forces of launch. This sudden deformation (collapse, shear, fracture, whatever) is responsible for the development of an initiating hotspot through friction or adiabatic compression. The property of interest here is the mechanical behavior of cast TNT or Composition B during high speed pressurization at the interface of a flaw site. The behavior of the explosives under these conditions is indicative of the heat energy that can be developed by dynamic mechanical deformation. This deformation can be quantified thereby providing values that can be used to evaluate the potential for mechanically induced ignition of modified TNT and Composition B formulations.

Cast Composition B and TNT are porous structures (refs 1, 2, and 4). Rapko (ref 5) suggests that the microvoids in these structures are created as the TNT freezes out from the melt. Volume differences between the solid and its melt cause crystals of TNT to separate from each other during crystallization leaving spaces between them. He further suggests that these spaces can be filled with TNT miscible additives that would modify mechanical properties and shock sensitivity, as was observed by Machacek, when chlorowaxes were added to Composition B (ref 3).

Chlorowaxes are a family of compounds, among others, that are miscible with TNT. This miscibility is the reason for this study. When TNT is melted these types of compounds distribute themselves uniformly throughout the melt on a molecular level. Microscopic examination suggests that when the melt freezes the TNT still crystallizes out in its normal manner as TNT. The additive, generally but not necessarily, a liquid, separates from the TNT filling the spaces created by the explosive's liquid or solid volume differential. This interpretation suggests several possible benefits. A liquid, coating each crystal and filling naturally occurring microvoids within a casting has the potential of functioning as a lubricant allowing crystals of explosive to slide past each other with a less than normal buildup of thermal energy. Secondly, it is quite conceivable that an additive filling up the pore structure and wetting individual crystals of TNT and RDX may act as an energy absorber which would increase the minimum ignition energy requirement and make the explosive less vulnerable to hotspot initiation. Filling the empty spaces of porosity in Composition B should also provide a means of controlling shock sensitivity (an important consideration in sympathetic detonation hazards). It is well known that porosity (a function of density) provides ignition sites, whose dimensions and numbers participate in determining an explosive's level of sensitivity to shock.

This work is directed toward evaluating the effect of chlorowaxes, as representatives of TNT miscible additives, on the mechanical behavior and shock sensitivity of TNT and the explosive ingredients of Composition B to determine whether or not the modifications made would be beneficial.

PROCEDURE AND RESULTS

Chlorowaxes are expected to impart a structural plasticity to castings of TNT and Composition B. To observe this property, hardware based on the design of the activator test was fabricated (fig. 1). An excess amount of explosive is cast in the center of a steel sample holder. The normally occurring irregular surface and piping cavity is machined flat to leave a pellet 0.300-inch long by 0.502-inches in diameter. This surface is placed against a steel punch containing a 0.250-inch diameter orifice which represents an open ended flaw for the explosive to be deformed through. The pellet, floating between two punches, is pressurized by the action of an air powered hydraulic Miller press, deforming and driving the explosive through the orifice in a manner related to its mechanical properties. The explosive's behavior in response to the applied forces is monitored with a piezo force gauge whose output is recorded with a Nicolet Explorer III digital oscilloscope. Ideally, ram travel should also be monitored during pressure loading. In lieu of this, a nonfragmenting rigid body and control formulation provide points of reference.

The experimental TNT and Composition B formulations were made with three chlorowax compounds (see appendix), identified as follows:

<u>Code</u>	<u>Chlorowax</u>	<u>Chemical formula</u>
A	45LV	$C_{12}H_{23}Cl_3$
B	57-60	$C_{13}H_{22}Cl_6$
C	70-200	$C_{11}H_{14}Cl_{10}$

Each of the chlorowaxes was incorporated with TNT or RDX and TNT to make the following modified TNT and Composition B type formulations:

TNT	97.5%	95.0%	90.0%	
Chlorowax	2.5%	5.0%	10.0%	
RDX	60.0%	60.0%	60.0%	60.0%
TNT	39.0%	38.0%	36.0%	30.0%
Chlorowax	1.0%	2.0%	4.0%	10.0%

Each experimental formulation is identified with its chlorowax letter code and the percentage used in the formulation. In the experimental Composition B type formulations as quantity of RDX was held constant at 60% while the amount of TNT compensated for the chlorowax content. 100% TNT was the control for the modified TNT formulations and RDX and TNT (60/40) for the experimental Composition B type formulations. Regular Composition B with petrolite wax, RDX/TNT/wax (60/39/1) is treated as an additional experimental formulation in the analysis.

A representative pressure versus time load cell response is shown with the figures for each of the twenty-two experimental formulations (dotted lines). Superimposed with the test is the appropriate control, and for reference the behavior of a nonfragmenting rigid solid. Examples of tests on modified TNT are shown in figures 2a through 2i and those for the experimental Composition B type formulations are shown in figures 3a through 3m.

The data as presented above provides a subjective impression of the effect TNT miscible additives can have on TNT and the ingredients of Composition B (RDX/TNT). In order to consolidate, quantify, and also provide some statistics the information recorded for all the tests was computer processed. Each test was differentiated with

respect to time and the results integrated with respect to the applied load to the pressure where total collapse of the structure through the orifice takes place (MPa^2/sec). Without a measurement of ram travel for evaluation of stress versus strain the numbers generated must be examined with caution. They can be used to compare the effect additives have on cast bodies for similar behavioral relationships, however, if a transition in the mechanism of collapse takes place, i.e., fracture to plastic flow, the values bridging the transition cannot be validly compared. With this proviso, the relative effect chlorowaxes have on castings of TNT is shown in figures 4a through 4c. The solid bar is the average, and the dotted lines span the error limits. The effect these additives and also Petrolite ES-670 wax have on the ingredients of Composition B (RDX/TNT) is shown in figures 5a through 5c. The RDX/TNT formulations with 10% additives are not included because a transition to plastic flow had occurred.

If TNT miscible additives reduce pore volume, it is expected that the explosive's sensitivity to shock initiation would also be reduced. The modified TNT formulations and Composition B1, with appropriate reference controls, were therefore tested for sensitivity to shock initiation with a slapper shock generator (refs 6 and 7). The tester uses energy stored in a low inductance capacitor system to propel a 2-mil mylar flyer plate to impact an explosive specimen which is pressed or cast within a steel sample holder (0.144 in. ID x 0.125 in. long). The flyer plate produces a shock profile in the sample under test. A linear relationship over the range of the tester between the shock generated depth of dent produced in a lead plate and the voltage on a charged 14.5 mfd. capacitor, thereby allowing this analog voltage to represent the shock energy is shown in figure 6. A 15-shot Bruceton up and down procedure is used to determine the 50% probability of a response to an analog of shock pressure stimulus (volts).

In order to demonstrate that shock sensitivity can be directly related to pore volume (a function of density) figure 7 is included. It shows a linear relationship, with a 0.998 correlation coefficient, for the effect of density of the analog of shock sensitivity for 5 micron RDX. With this as background, the shock sensitivity related data for TNT and its modifications are shown in figures 8a through 8c and the experimental formulation Composition B1 is shown in figure 9 with regular Composition B for reference.

RESULTS

An examination of the pressure versus time deformation curves will show that the controls, standard TNT and the explosive ingredients of Composition B (RDX/TNT, 60/40), track the behavior of a rigid body until a sudden collapse of the structure into the orifice takes place. Examination of the fragments showed that the entire structure of the pellets had been pulverized almost as if it had been ground with a mortar and pestle. Even the portion that had been reconsolidated by the continued travel of the ram was unstructured, weak, and very porous. Regular Composition B also tracks the behavior

of that rigid body, but the presence of the 1% Petrolite wax additive lowers the pressure at which breakup occurs. The reconsolidated fragments are also weak and porous, but show signs of structure and body. The presence of the wax seems to function as a binder for the pulverized reconsolidated fragments that subjectively appears to make the material less porous in comparison with the control, RDX/TNT (60/40).

The chlorowaxes modified the mechanical behavior of TNT as expected. With modest amounts (2.5%), the modified materials tracked the behavior of 100% TNT and the rigid solid. The additives appeared to function as lubricants in the castings which reduced the pressure required to collapse the pellets through the orifice. As additive quantities are increased further reductions are experienced, however, a plasticity in the mechanism of collapse is indicated.

The chlorowaxes did not perform in the same manner when RDX was added to TNT/chlorowax to make various Composition B type formulations. The chlorowaxes in 1%, 2%, and 4% concentrations did not change the mechanical behavior of the experimental formulations in a significant manner with respect to each other and regular Composition B. Only with excessive 10% additives was a marked change in mechanical behavior observed. The collapse mechanism through the orifice had changed from a fracture type to plastic flow and this strongly pointed out the potential for a serious hazard situation.

The loading rate induced stresses experienced by the explosives in these experiments are very modest when compared with the stresses that can be induced in the base of a projectile during gun firings. Even so, each of the RDX and TNT formulations with 10% chlorowaxes exhibited evidence of a possible ignition. Centered at the base of all pellets, reconsolidated from the crushed fragments, was a burn spot. The crushed material had a damp appearance and consistency of play dough and it is suggested that under dynamic loading the nature of the material, as influenced by additives, can block out air flow thereby concentrating air volumes for heating by adiabatic compression. If this interpretation is correct then it follows that the chlorowax formulations with lesser concentrations are also subject to this adiabatic compression hazard; it is merely a matter of degree that would be exposed by higher loading rates.

Carrying out this argument one step further points the finger of responsibility for inbore explosions at the presence of wax in Composition B. The crushed material and behavior during breakup and recompaction appear to be virtually identical with the formulations where chlorowaxes were substituted for wax. And if, as suspected, the presence of these materials contribute to making the RDX/TNT more vulnerable to heating through adiabatic compression then so too could the wax.

The development of these suspicions should change the direction of the work taken in the Composition B improvement program. The potential for an inbore hazard situation appears to be associated more with its characteristics when broken and crushed

than with the nature of the original casting. Without any additives there is a looseness to a pulverized compacting body of RDX/TNT (60/40) that, it is suggested, is more capable of absorbing and distributing a preceeding (collapsing) bubble of air throughout the material. The presence of additives of any type investigated thus far (including wax) appears to function as a binder for this pulverized material making it less permeable to air flowing from a bubble in compression, thereby concentrating the air for adiabatic heating.

Inbore ignition of Composition B can occur within either of two specific time frames: during the time of material breakup or afterwards, or during compaction of the fragmented material. The experiment, as conducted here, does not address these two areas of concern. Only a subjective impression of material behavior after breakup is obtained from visual examination and the character of the load trace, i.e., jagged versus smooth. For this evaluation the test fixture should be redesigned to deform an explosive pellet into a smaller fixed volume cavity. This test should be performed at several pellet volume to cavity volume ratios while monitoring ram travel for the generation of stress versus strain type data. Simultaneously, a fast response thermally isolated thermocouple or infrared microscope at the base of the cavity would measure the temperature rise of the collapsing volume of air. In total, this type of data should provide the information necessary for evaluating the potential for an adiabatic compression hazard additives may have on castings of RDX/TNT.

It can be inferred from the results of the shock sensitivity "slapper" test that miscible additives can reduce pore volume and thereby provide a means to shock desensitize RDX/TNT. This however is accomplished, as indicated here, with the potential tradeoff of making the explosive more sensitive to ignition through adiabatic compression. At this point in the Composition B improvement program it is time to take a step backwards and ask, is there a good reason for using wax or any other such material in Composition B? The literature and discussions with colleagues did not produce a great deal of experimental evidence supporting the use of wax. Some waxes reduced the number of rejects due to defective castings, but its major proven contribution to explosive safety (refs 1 and 8) is to slow the reaction rate of the explosive during the early stages of combustion. However, this can be accomplished more effectively with the reduction of pore volume through pressure casting (refs 1 and 2) and protecting the RDX with precoated additives (ref 9).

The reduction of pore volume through pressure casting appears to be a simple and effective approach for improving quality of castings and the safety of RDX/TNT (60/40); simultaneously addressing both the deflagration and detonation hazards of the explosive and because no additives are present to abet ignition through adiabatic compression. Internal surface areas and ignition routes (porosity) are the principal contributors to the hazardous reaction rate (deflagration) of Composition B and therefore DDT. If the microvoids of porosity could be totally removed from the explosive, it could only burn on its exterior surface with a burning rate exponent in the neighborhood of one. This is very

slow burning and would preclude inbore explosions in addition to preventing a transition to detonation in any standard weapon system. However, the total elimination of porosity would not be desirable. Microvoids in the structure provide necessary ignition sites for the propagation of detonation. It is reasonable to expect that pore volume could be controlled in the explosive as a function of the applied pressure during pressure casting of the explosive melt. Hopefully, this would provide a balance between a safe deflagration rate and adequate performance (detonation).

The sensitivity of RDX is the dominant parameter in hazard situations associated with Composition B. If after thorough evaluation of the effect pore volume has on the relationship between reaction rate, shock sensitivity, and performance it is felt that an additional margin of safety is required, this can be provided by bonding a thin protective coating on the surface of the RDX crystals (refs. 1, 2, 8, and 9).

A perfectly cast billet of Composition B that can not move or break up within the projectile during launch could be much more sensitive than it is without experiencing an inbore explosion. Pressed PBX explosive fills fall into this category. A flaw of some sort is necessary to precipitate the hazard, It is more important to improve cast quality and eliminate the potential for flaws than it is to desensitize its ignition and burning parameters. Conceivably, pressure casting may also provide the opportunity to do so by improving surface contact with the base and walls of the projectile while also displacing or compressing air bubbles. The concept should be tested (with special attention to environmental caused cracking and creeping) on neat RDX/TNT before an attempt to improve cast quality is made with additives such as HNS.

CONCLUSIONS AND RECOMMENDATIONS

This work develops the strong suspicion that adiabatic compression is the principal ignition mechanism responsible for inbore explosions with Composition B and that it is the presence of the wax in the explosive which abets the problem. It is believed that it does this because a flaw in combination with launch induced stress can cause the material to be virtually pulverized, permitting the wax to function as a binder in the recompacting powderlike fragments. This can make the fragments less permeable to airflow in the consolidating material, thereby confining the air for adiabatic heating. This brings into question the concept and purposes for using wax or any other material with castings of RDX/TNT.

It is time to take a step backwards to determine if a safer Composition B can be made without the use of additives. It is suggested here that this may be accomplished through pressure casting. Cast Composition B is a porous structure in which the pore volume controls reaction rate during simple burning, its shock sensitivity, and detonation

velocity. It would appear that this pore volume can be manipulated and fine tuned with pressure casting during solidification of the melted explosive, with the objective of improving safety in DDT and SDT hazard situations. The concept of pressure casting also has the potential of improving cast quality, thereby, mitigating the fundamental cause for the inbore explosion problem.

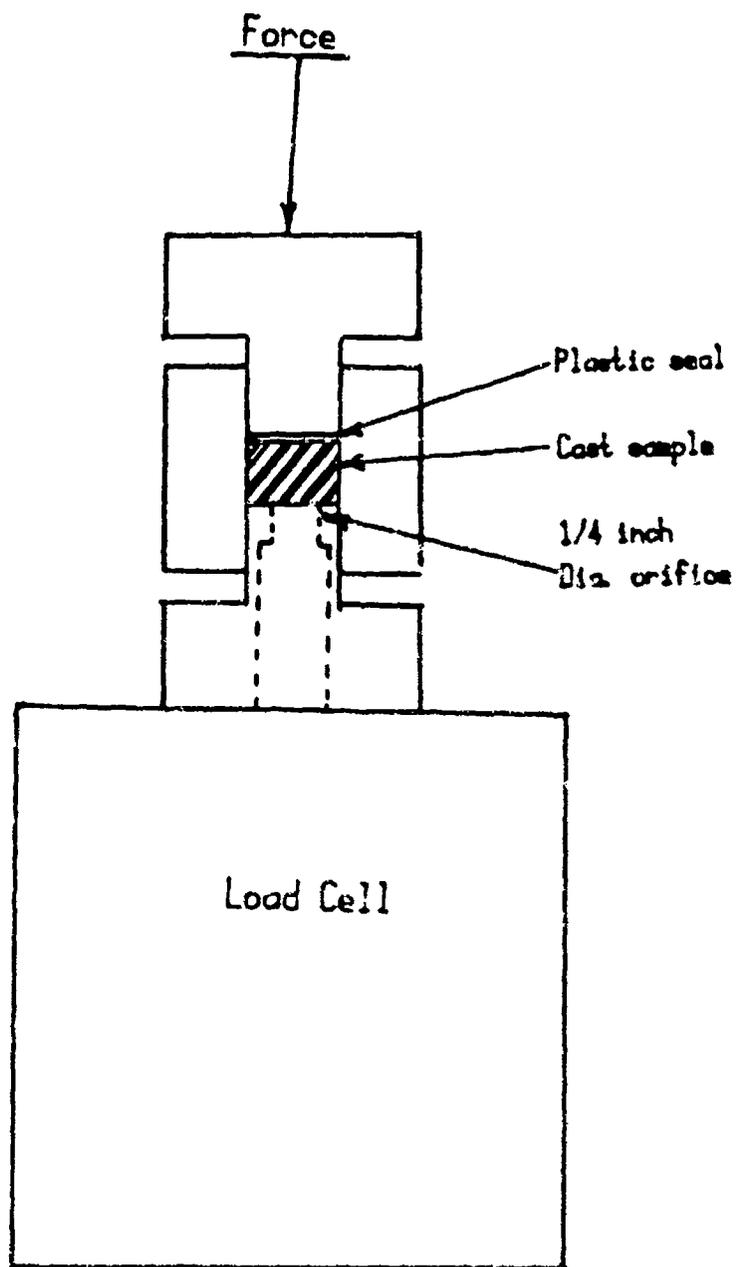


Figure 1. Dynamic deformation test fixture

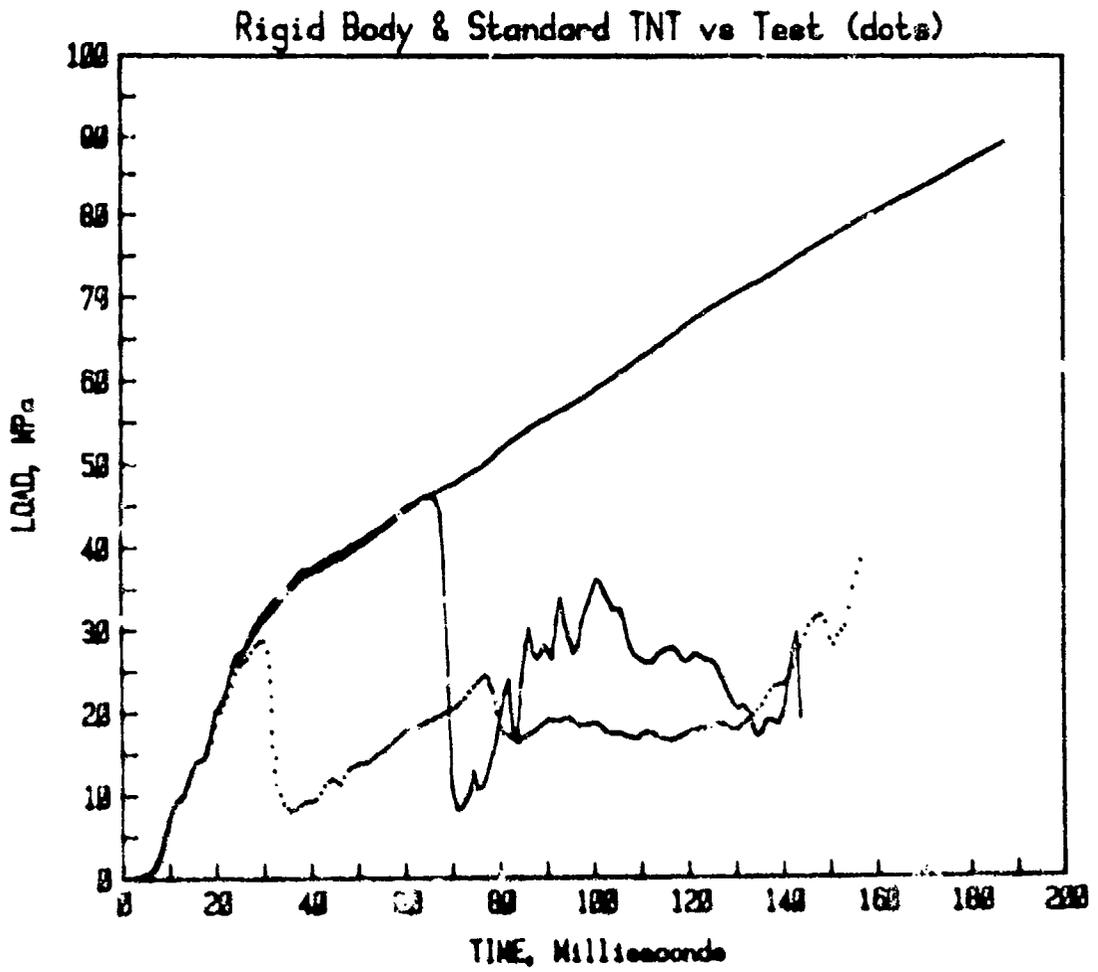


Figure 2a. TNT mod A2.5 (97.5/2.5)

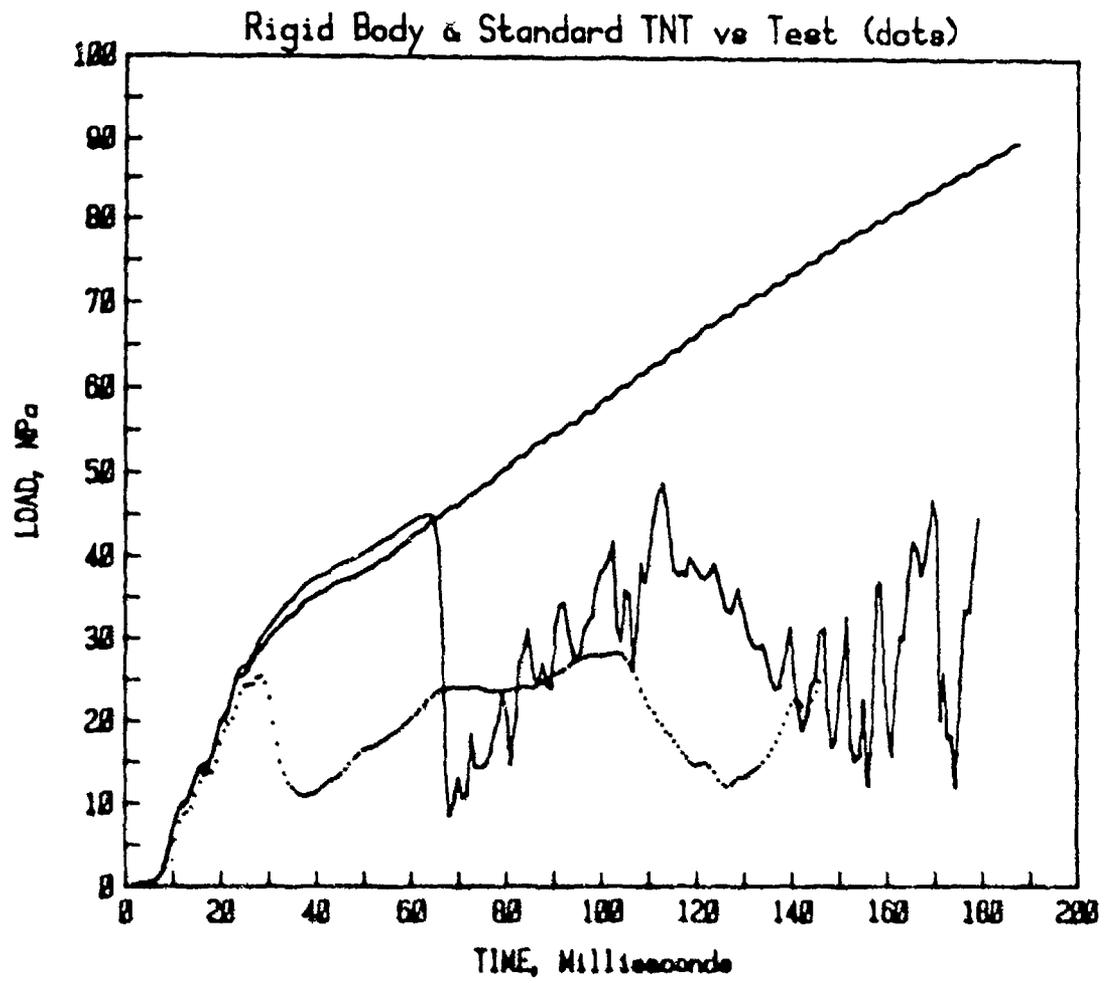


Figure 2b. TNT mod B2.5 (97.5/2.5)

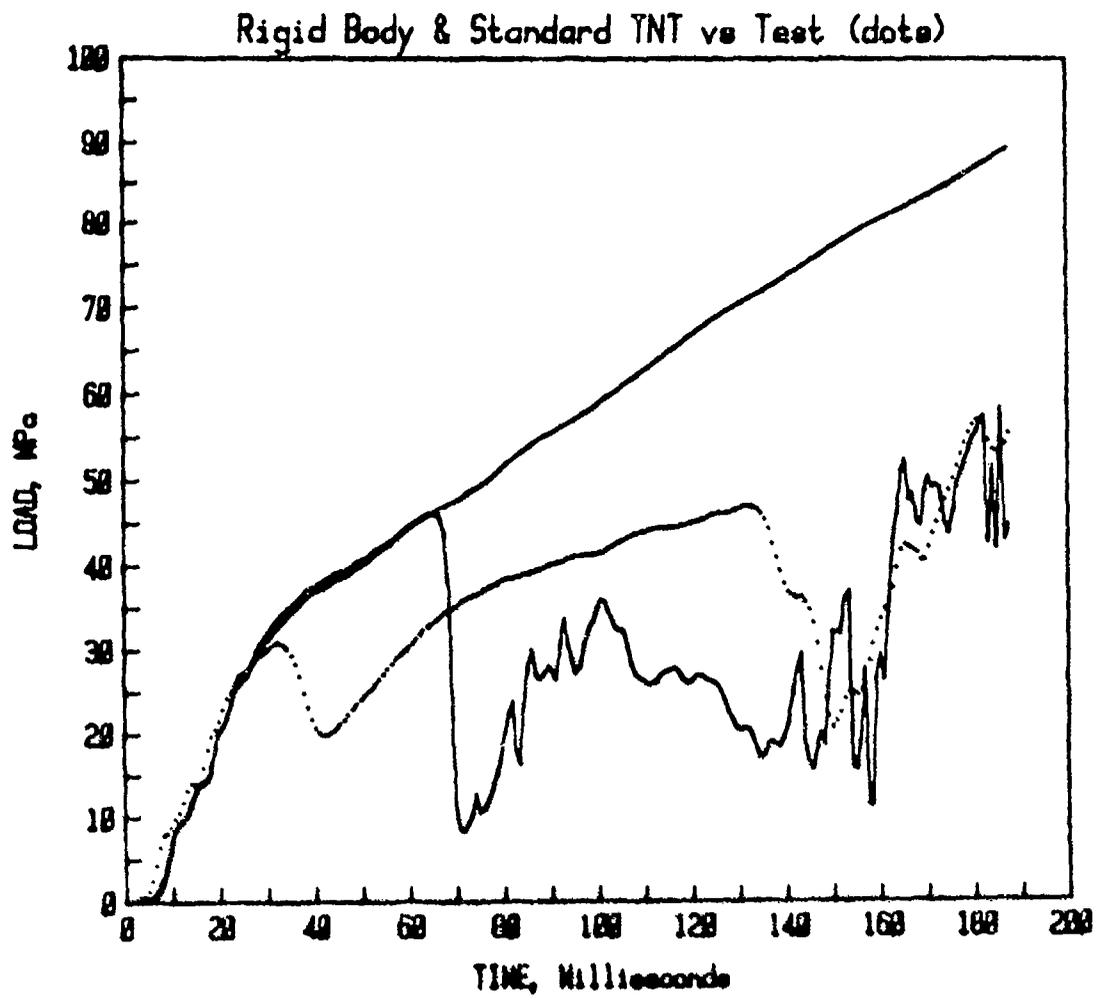


Figure 2c. TNT mod C2.5 (97.5/2.5)

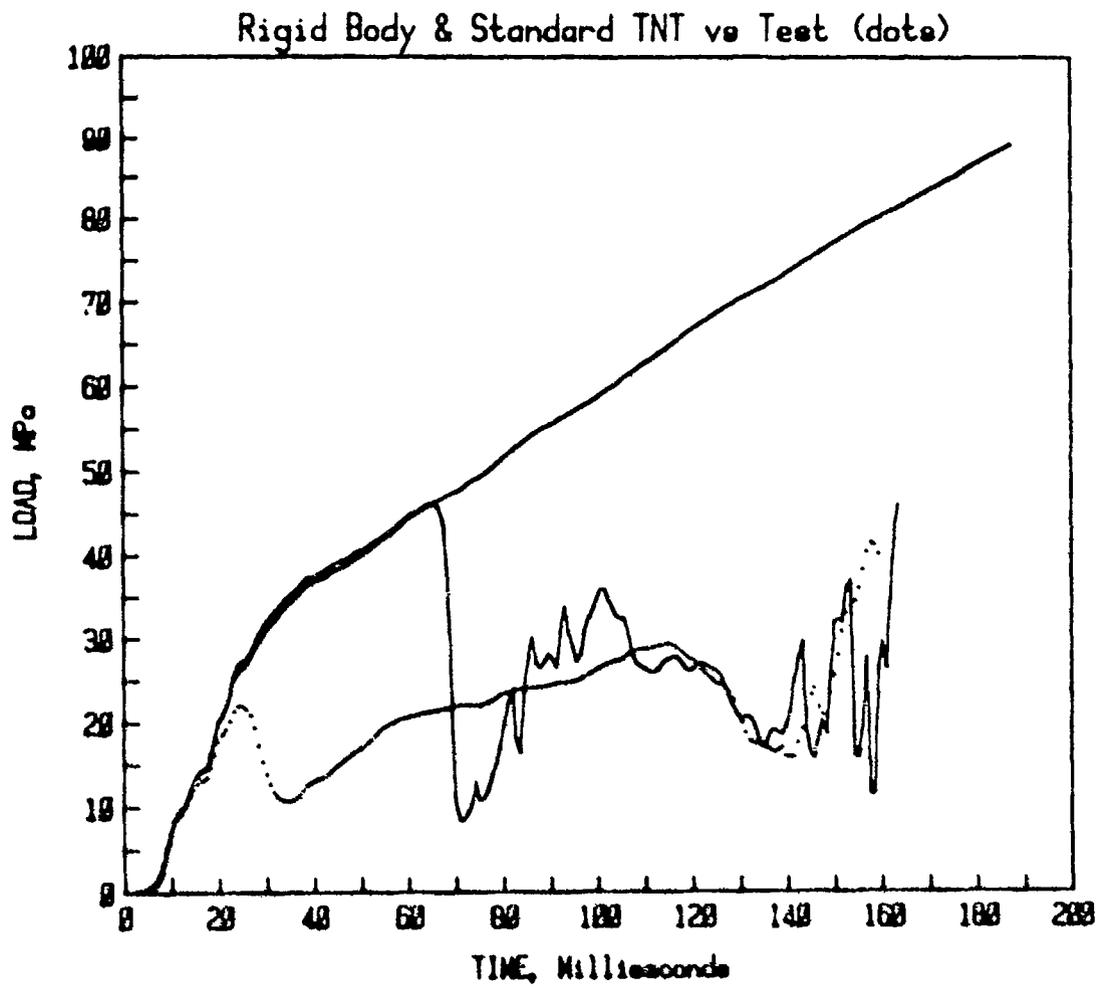


Figure 2d. TNT mod A5 (95/5)

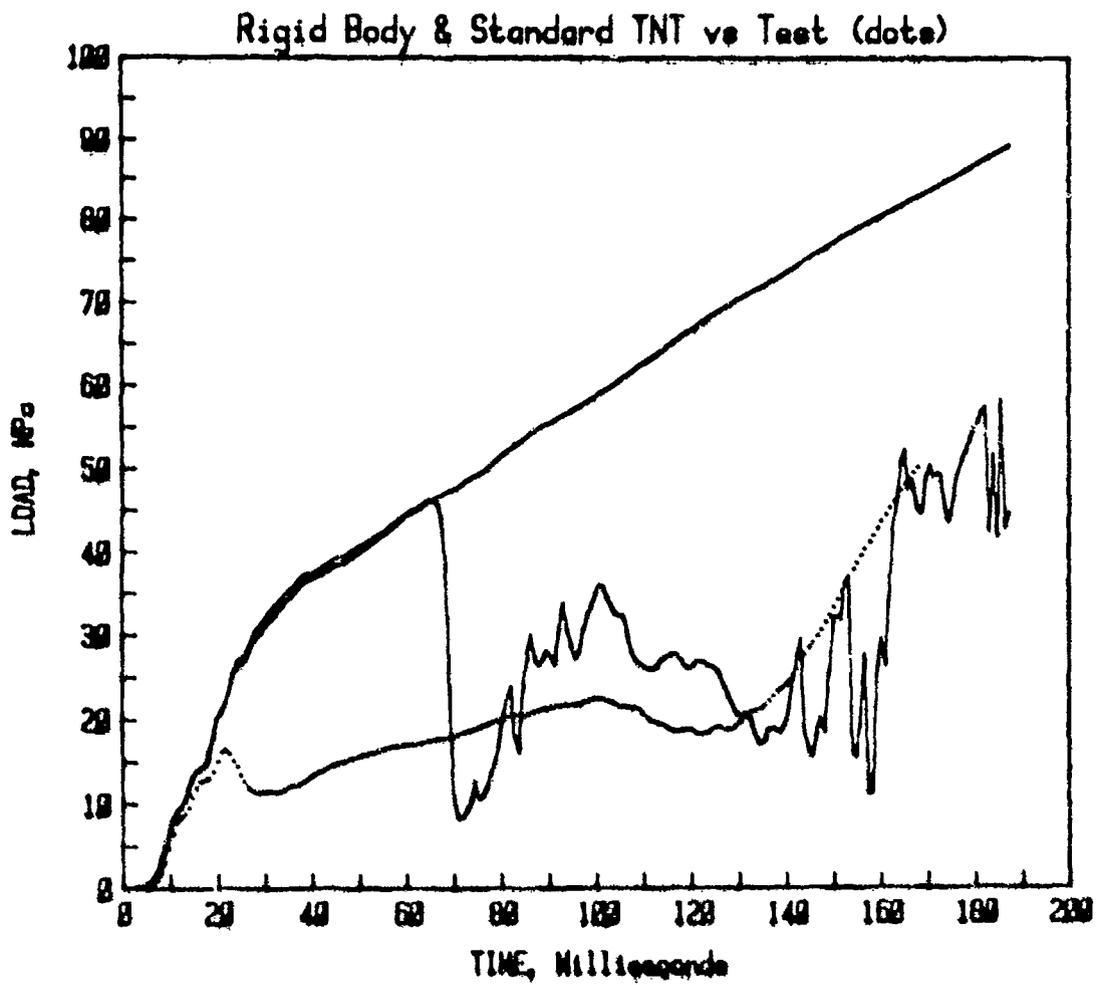


Figure 2e. TNT mod B5 (95/5)

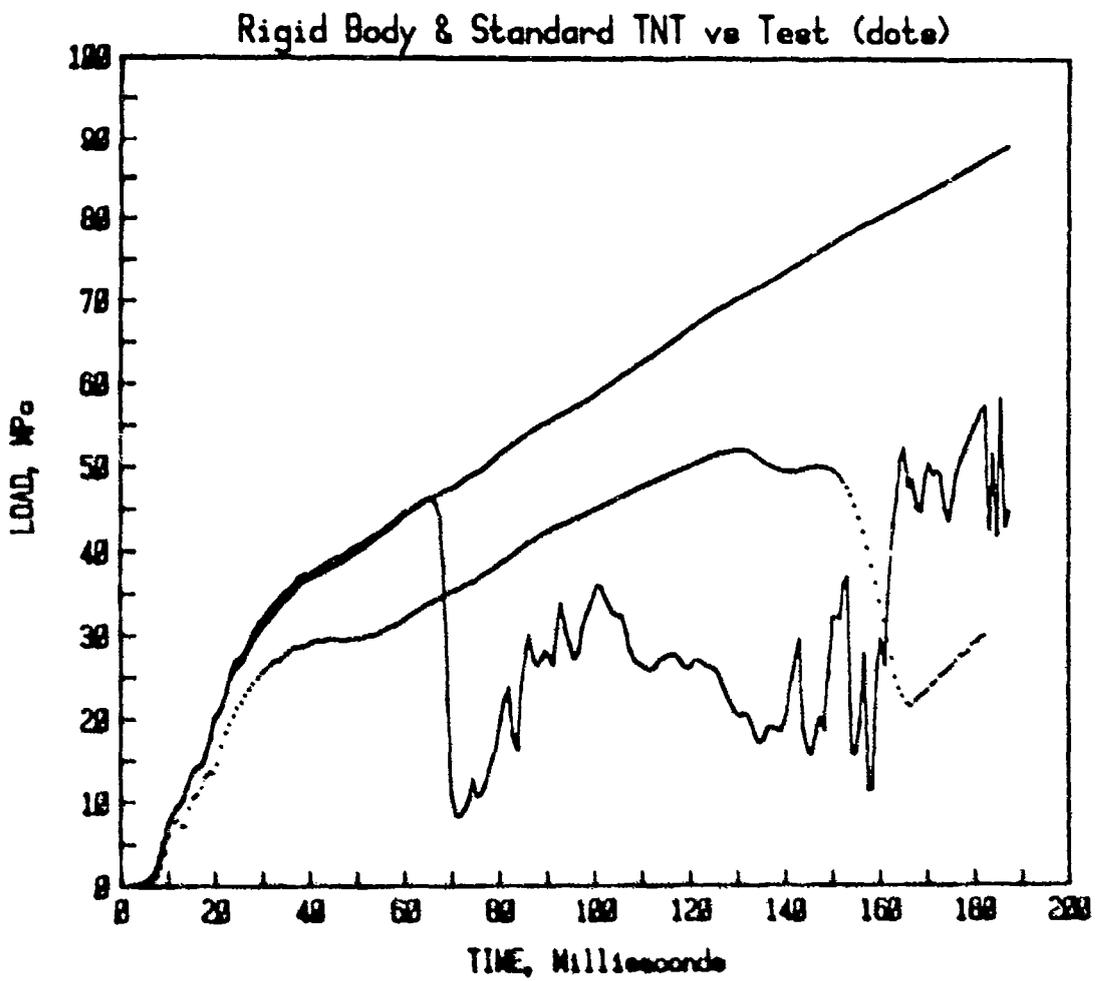


Figure 2f. TNT mod C5 (95/5)

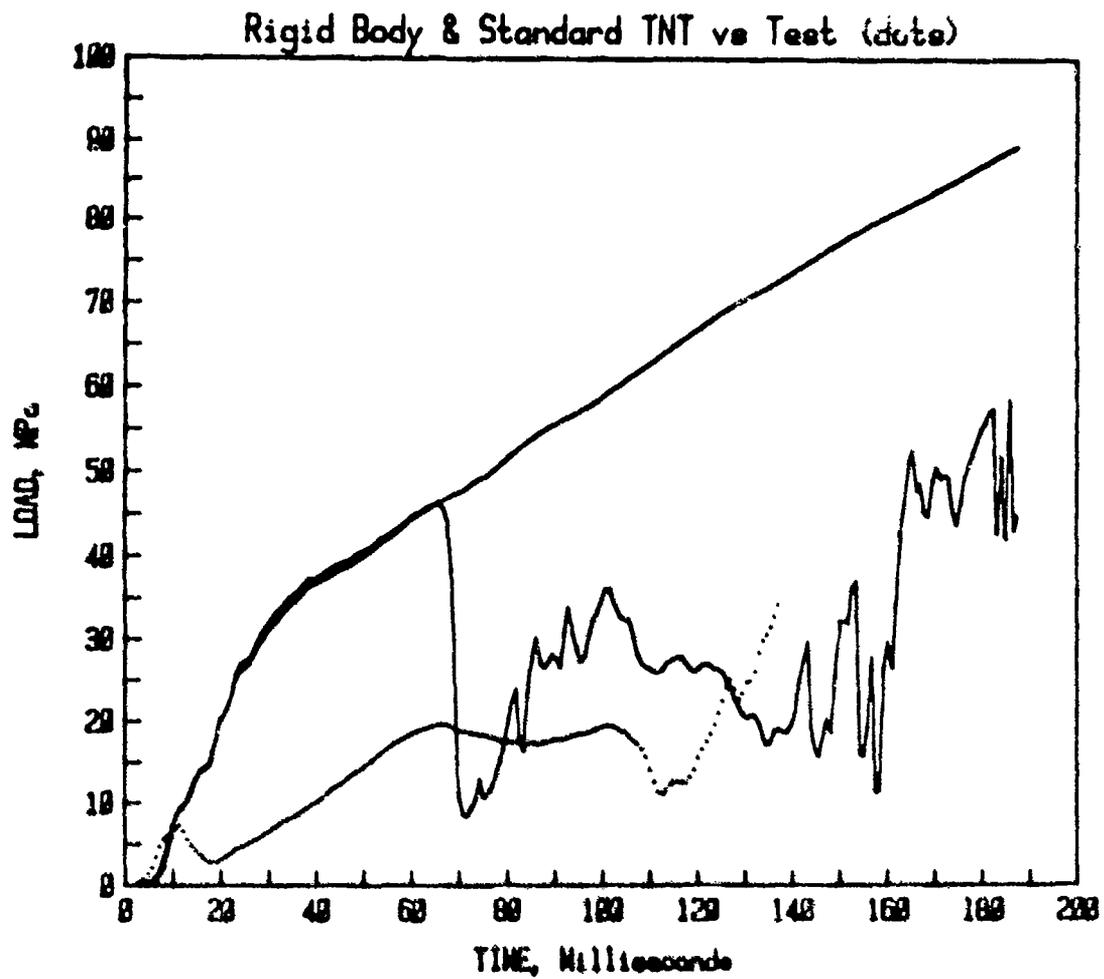


Figure 2g. TNT mod A10 (90/10)

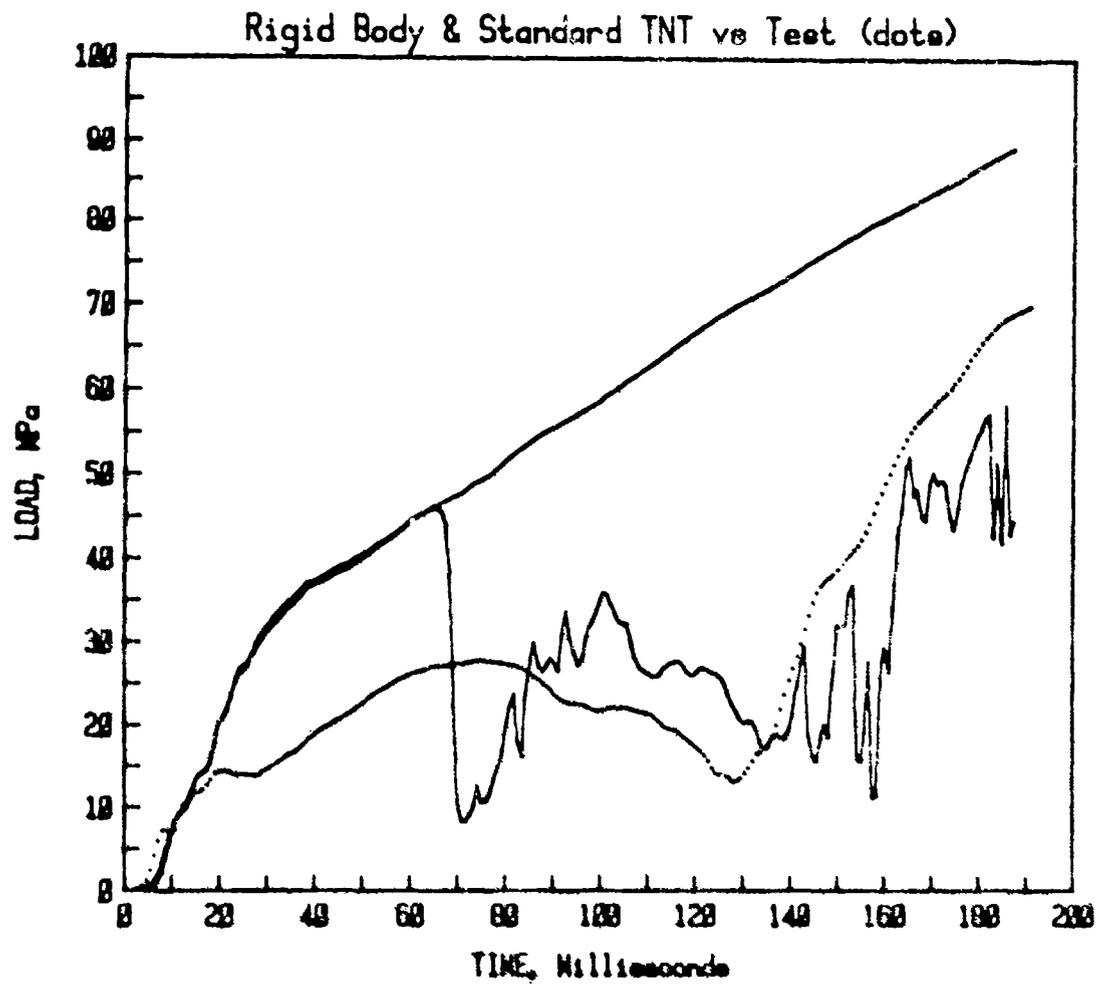


Figure 2h. TNT mod B10 (90/10)

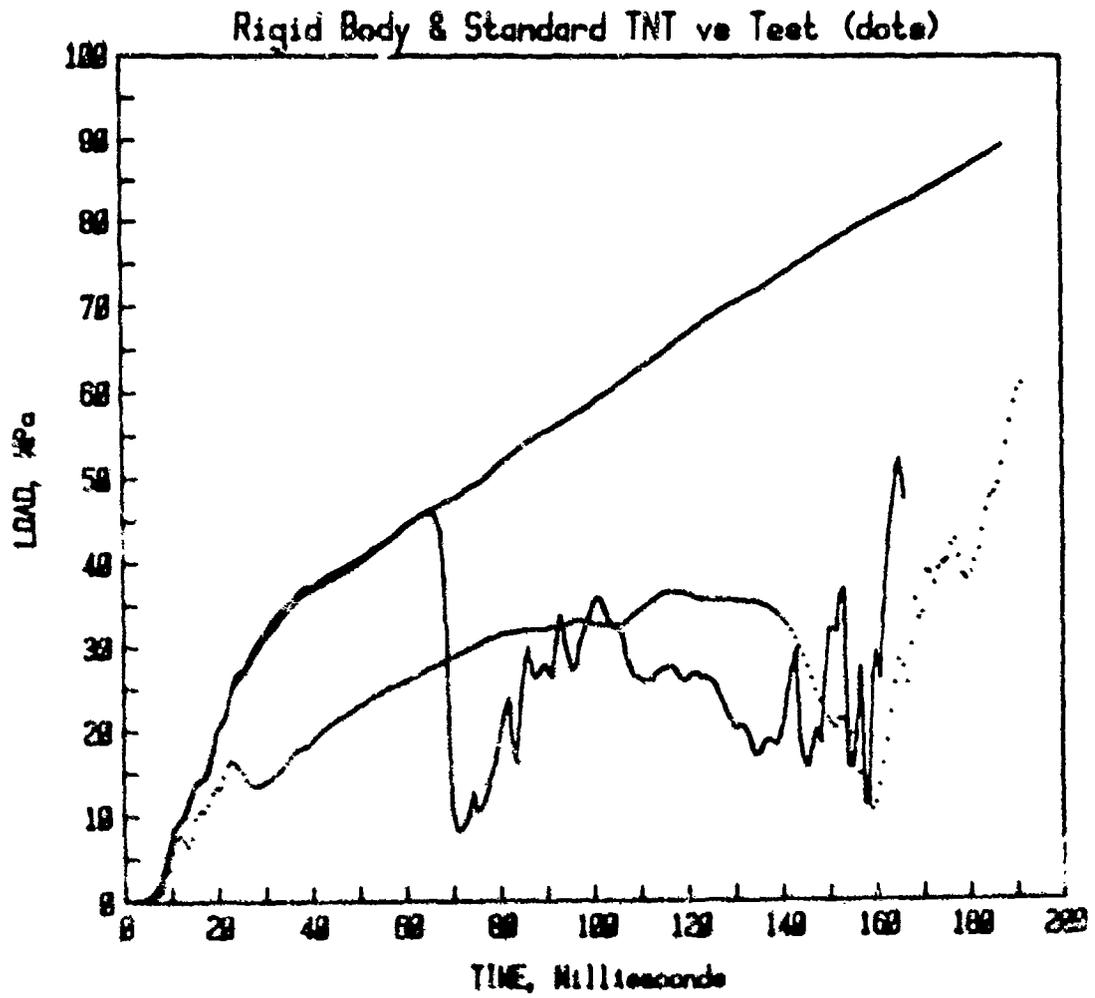


Figure 2i. TNT mod C10 (90/10)

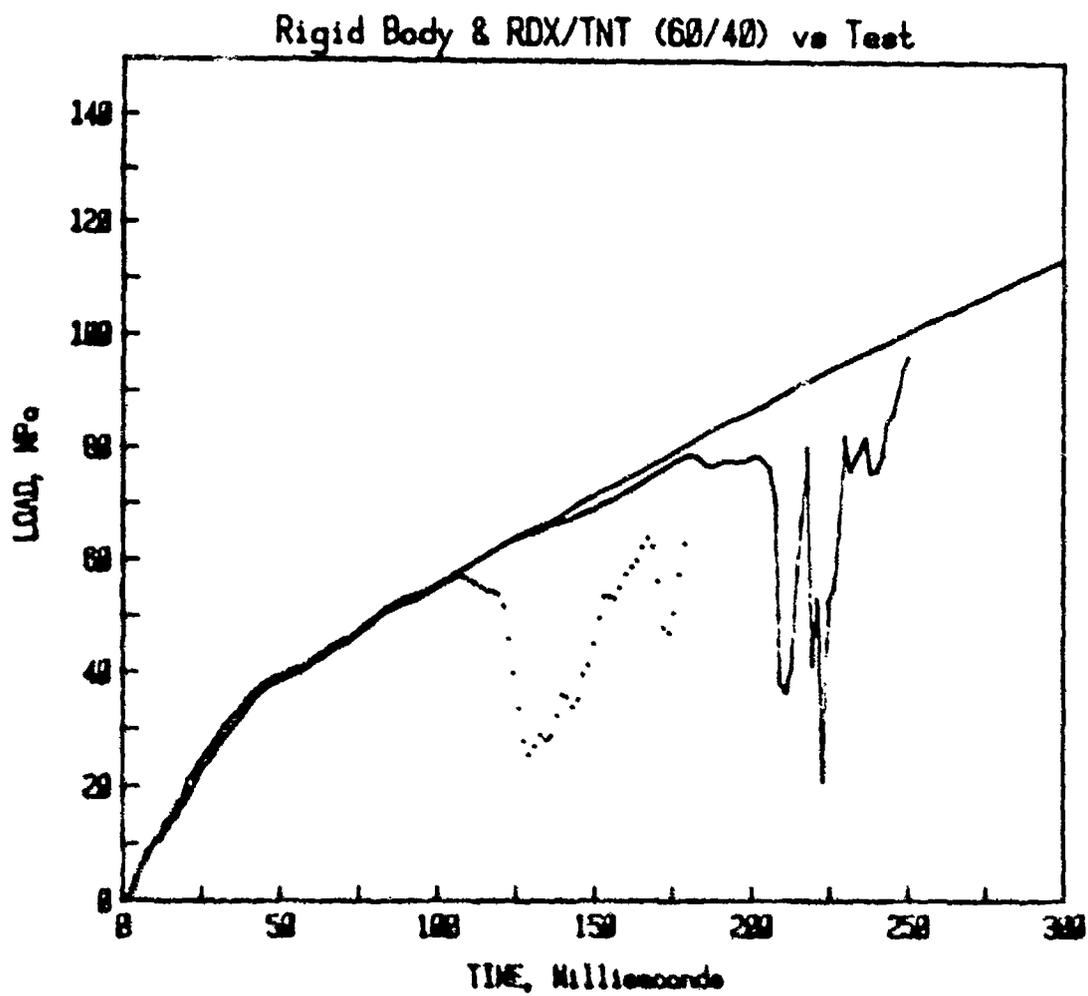


Figure 3a. Regular Composition B (wax)

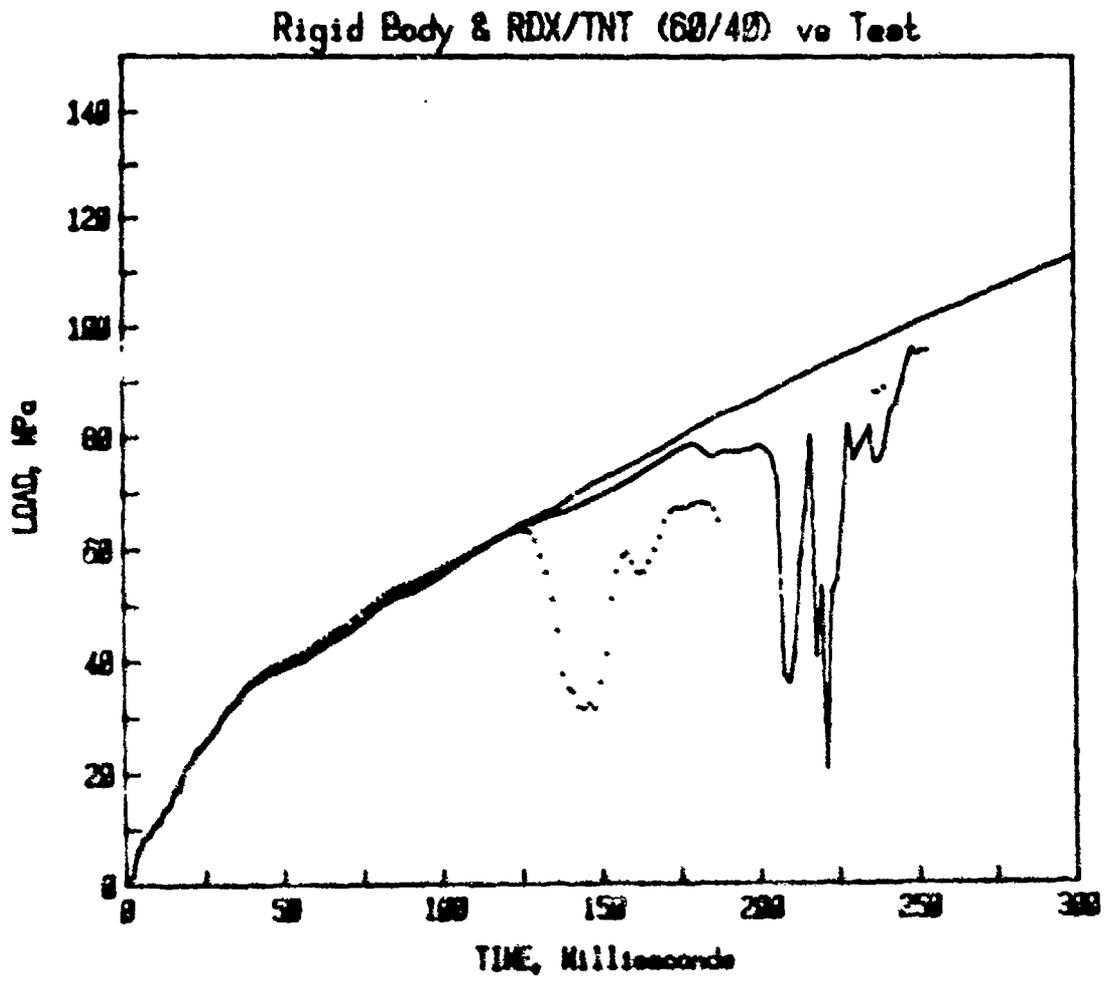


Figure 3b. Comp A1 (60/39/1)

Rigid Body & RDX/TNT (60/40) vs Test

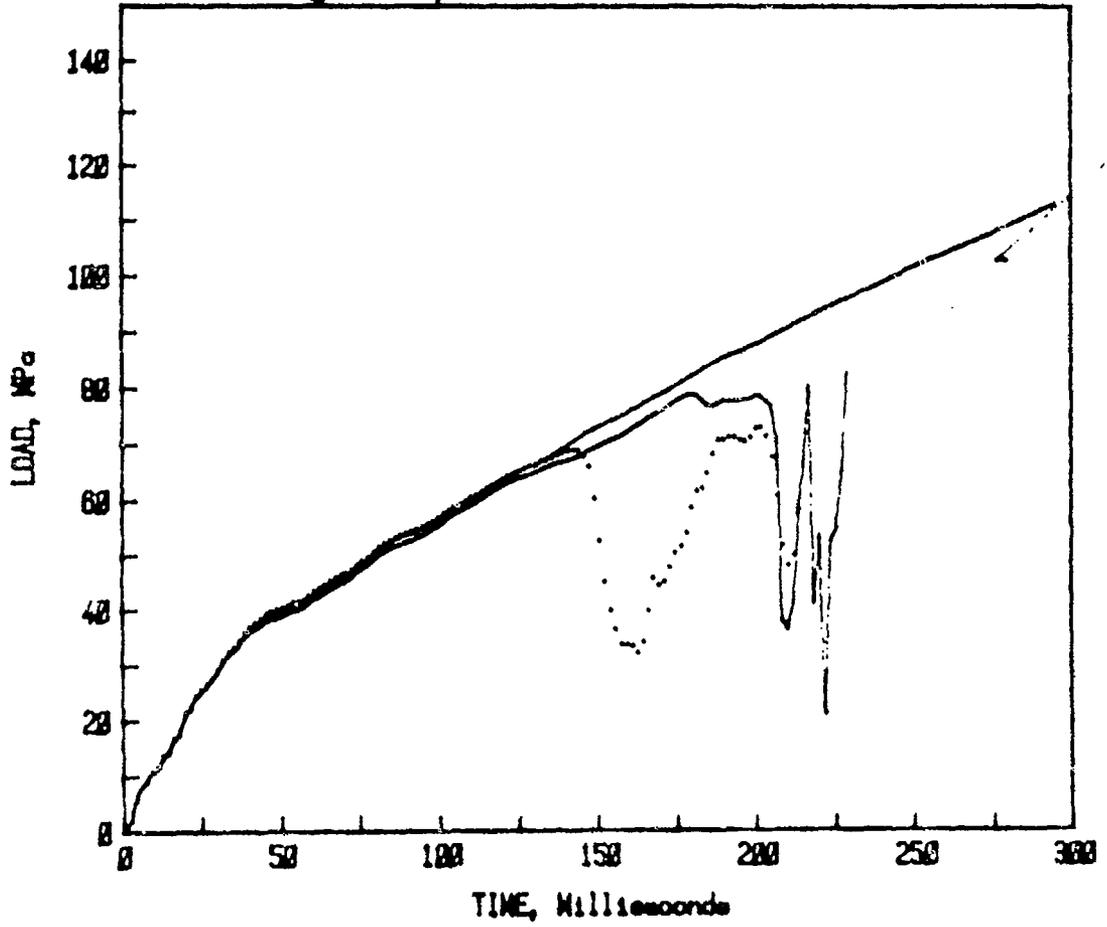


Figure 3c. Comp B1 (60/39/1)

Rigid Body & RDX/TNT (60/40) vs Test

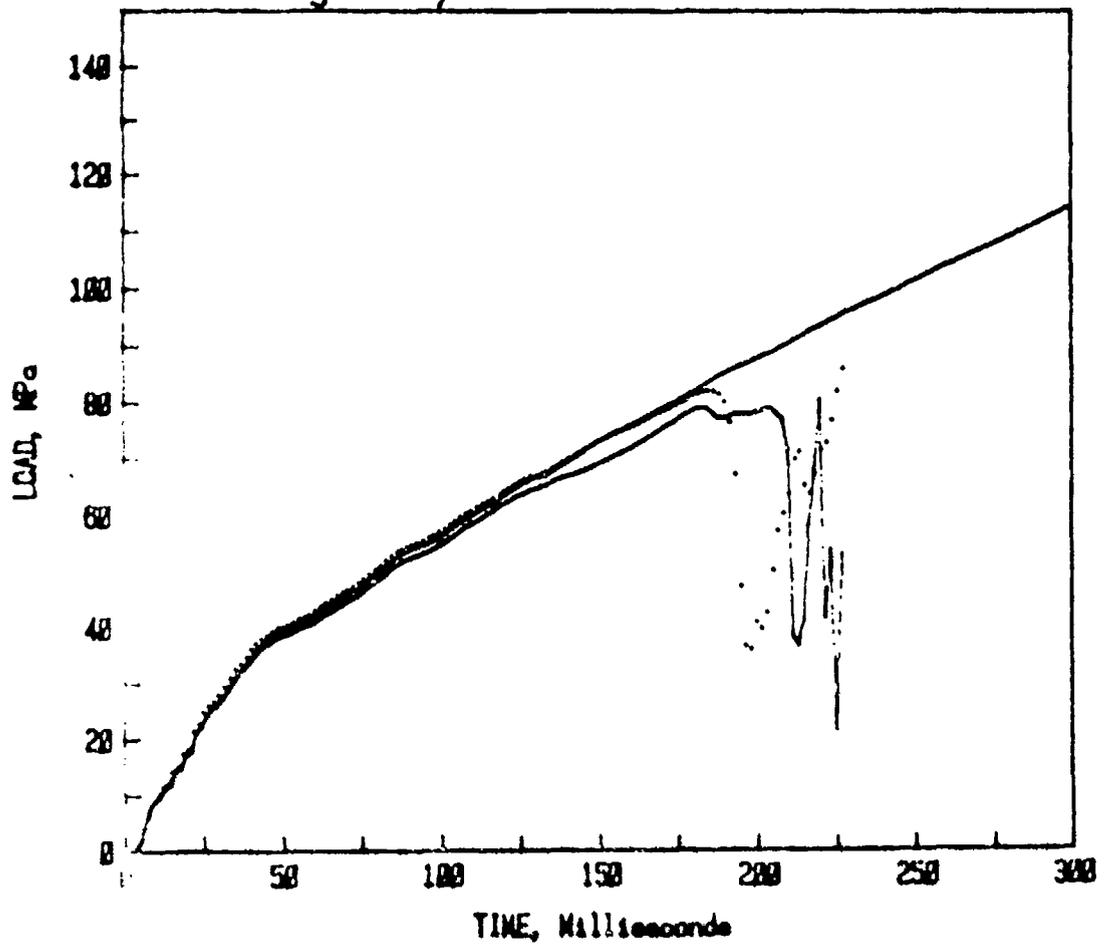


Figure 3d. Comp C1 (60/39/1)

Rigid Body & RDX/TNT (60/40) vs Test

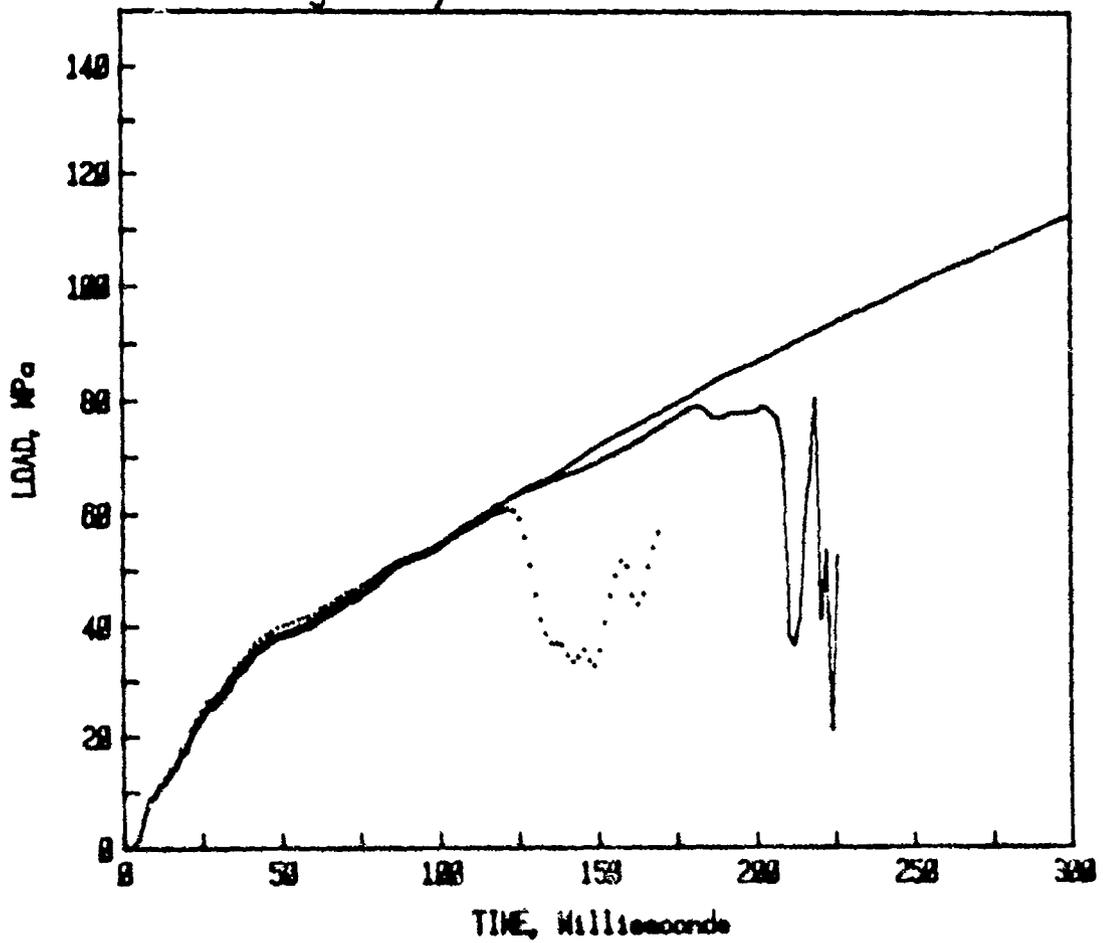


Figure 3e. Comp A2 (60/38/2)

Rigid Body & RDX/TNT (60/40) vs Test

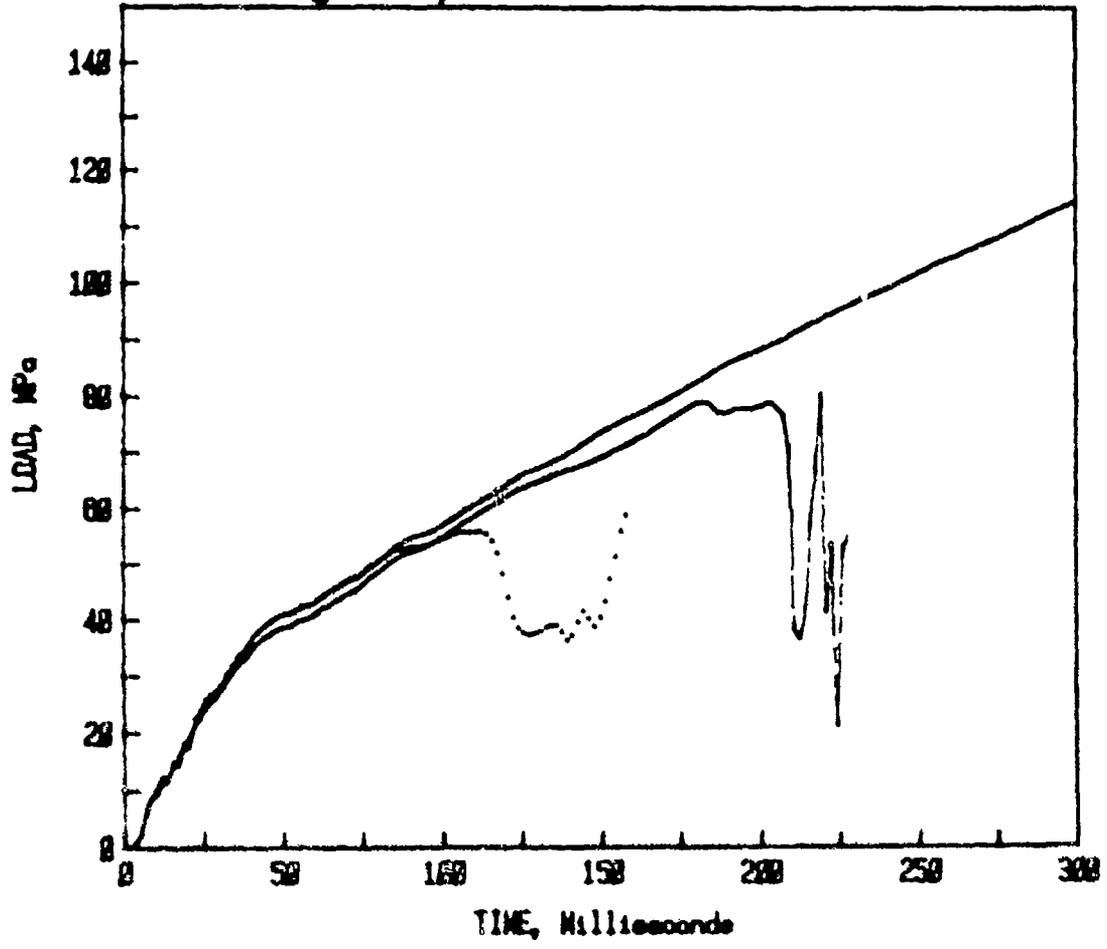


Figure 3f. Comp B2 (60/38/2)

Rigid Body & RDX/TNT (60/40) vs Test

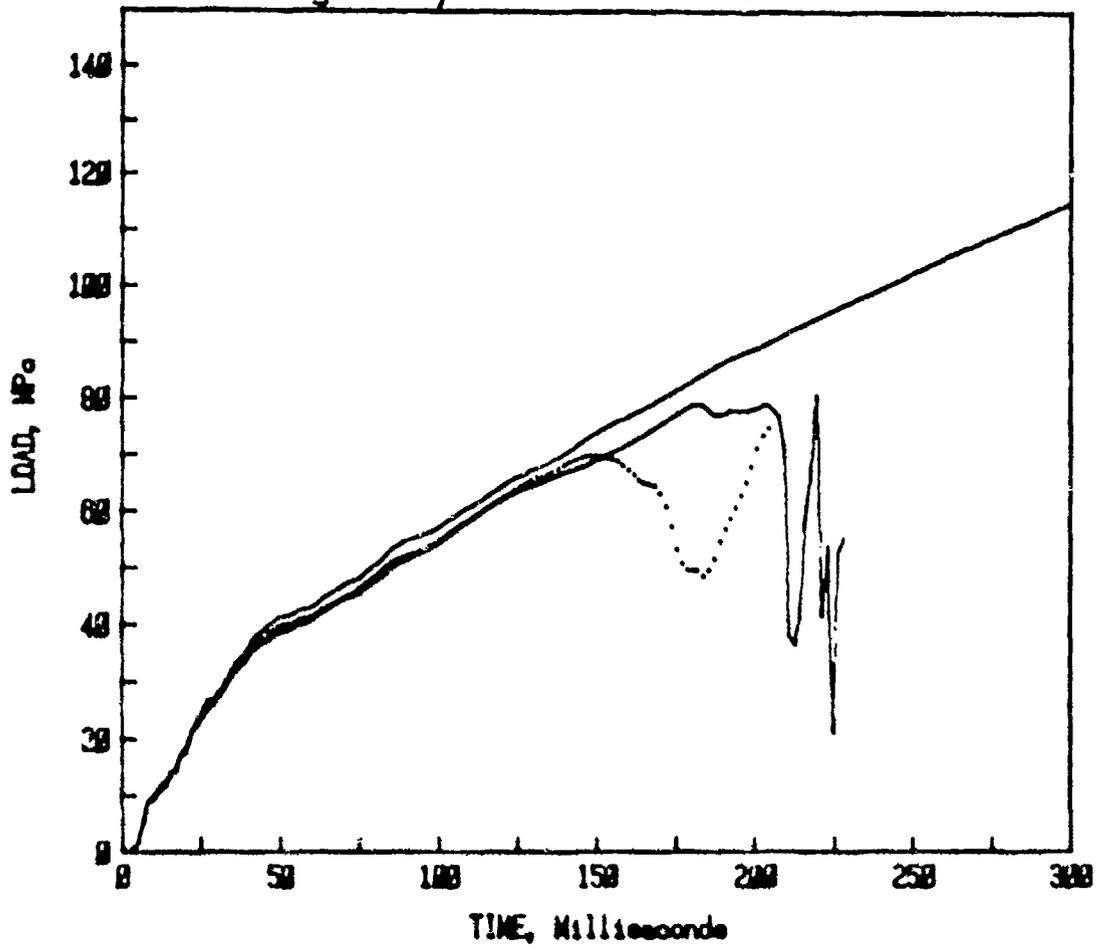


Figure 3e. Comp C2 (60/38/2)

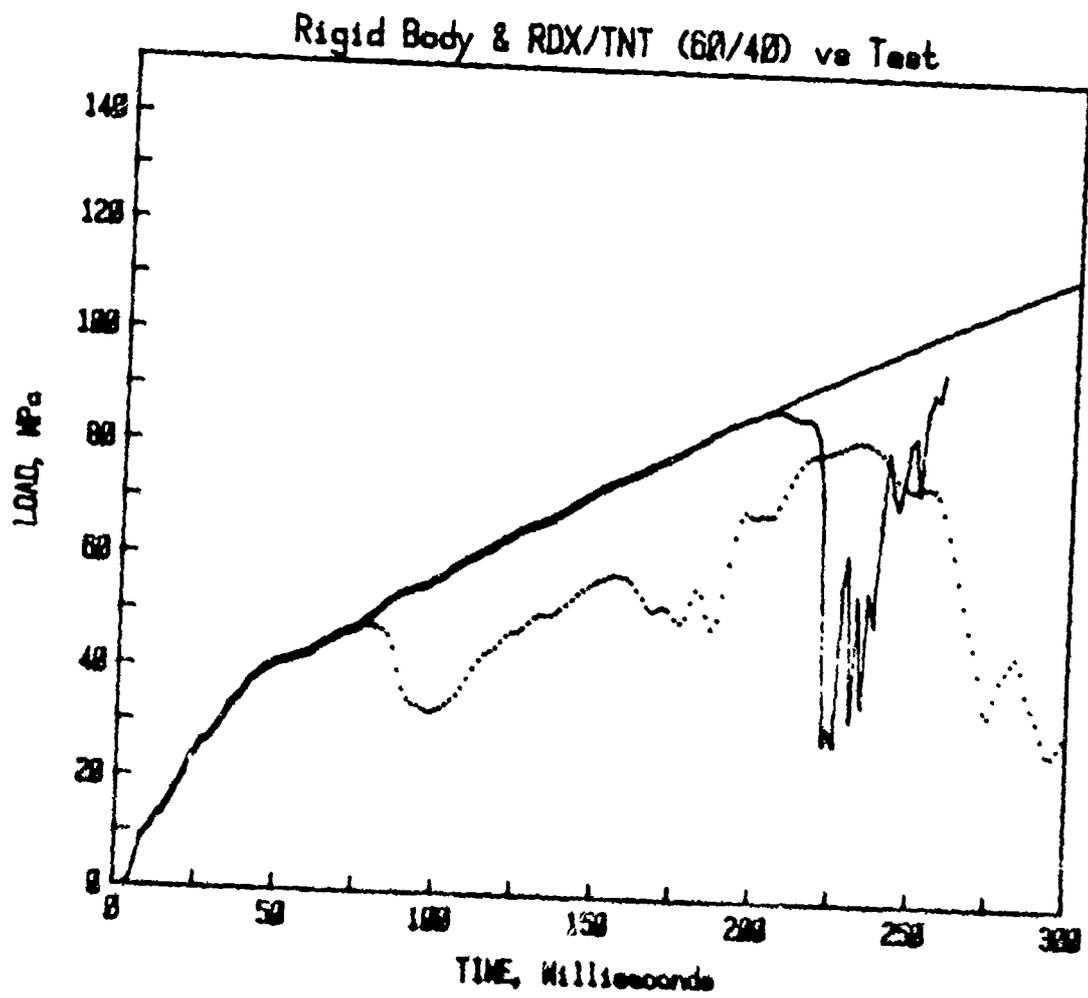


Figure 3h. Comp A4 (60/36/4)

Rigid Body & RDX/TNT (60/40) vs Test

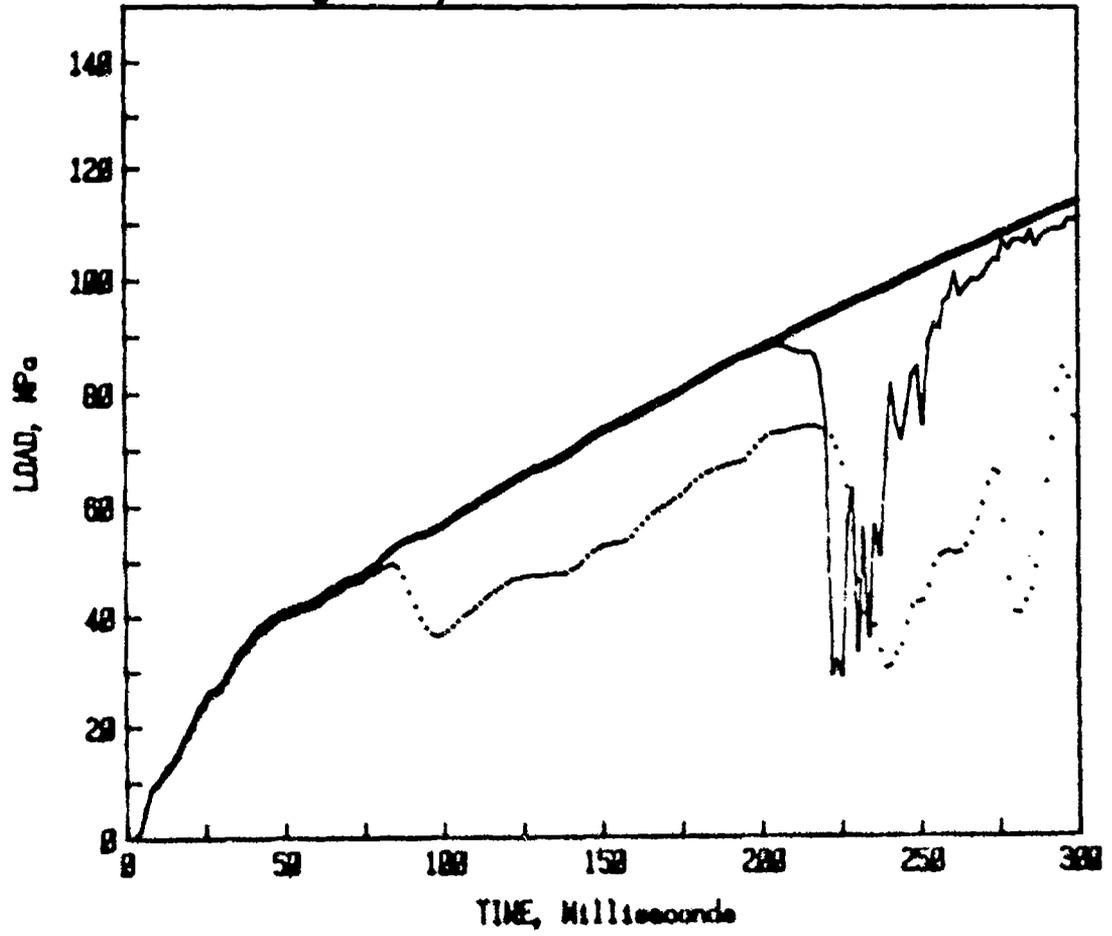


Figure 3i. Comp B4 (60/36/4)

Rigid Body & RDX/TNT (60/40) vs Test

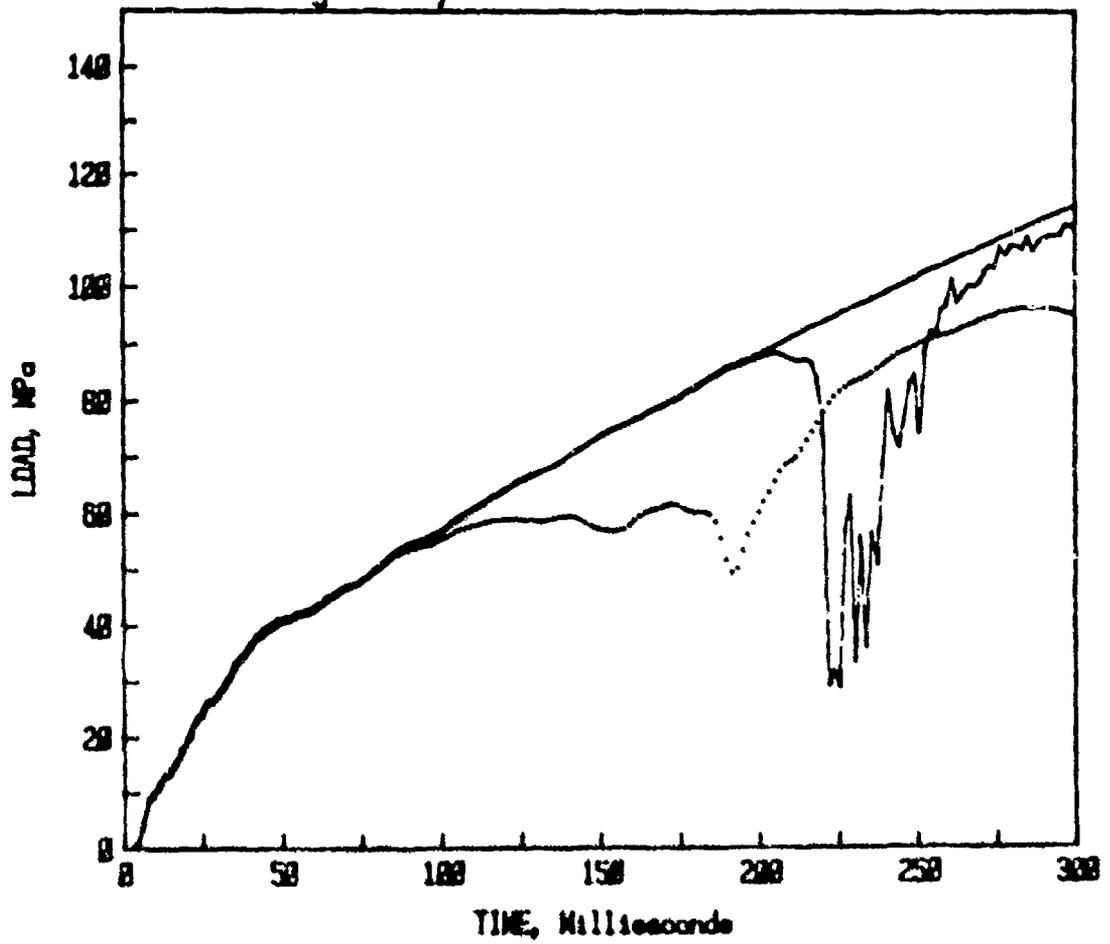


Figure 3j. Comp C4 (60/36/4)

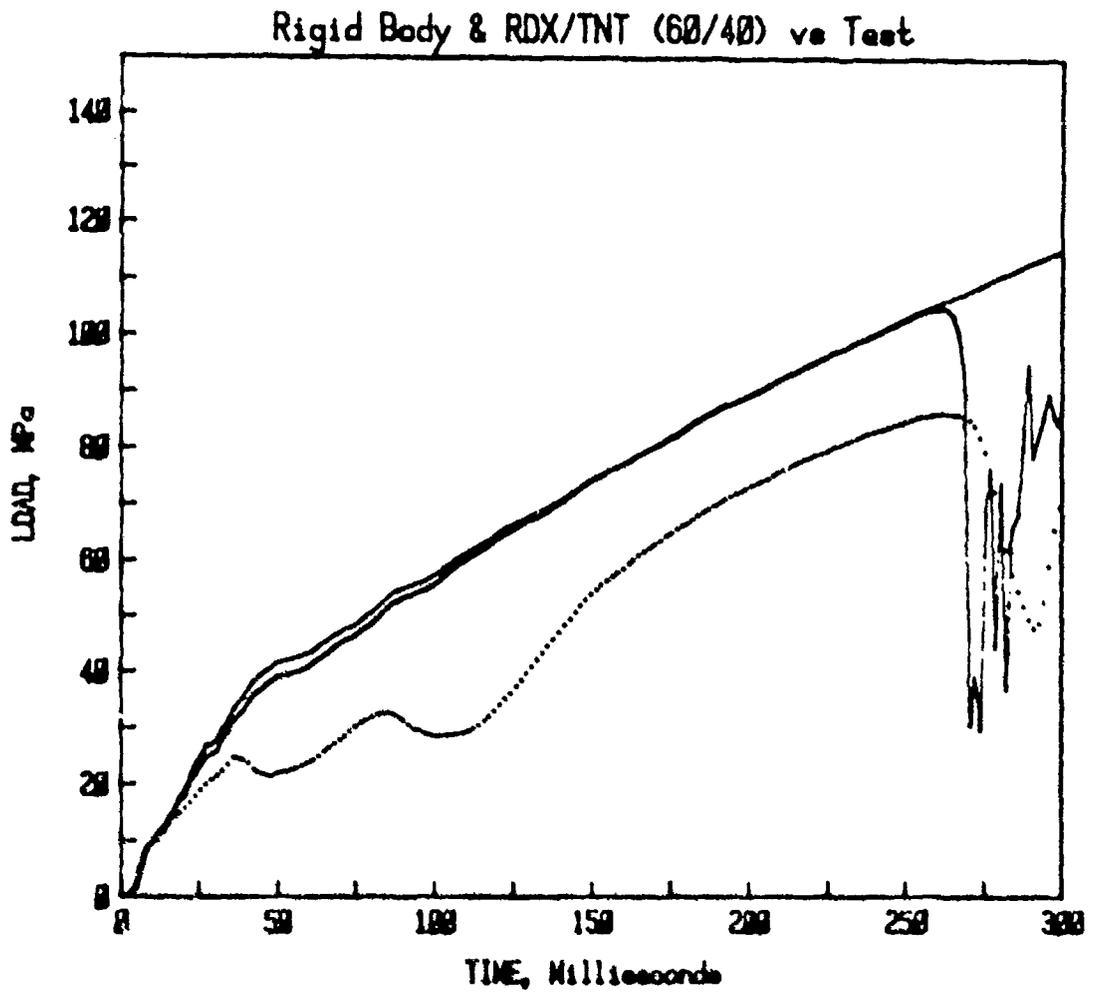


Figure 3k. Comp A10 (60/30/10)

Rigid Body & RDX/TNT (60/40) vs Test

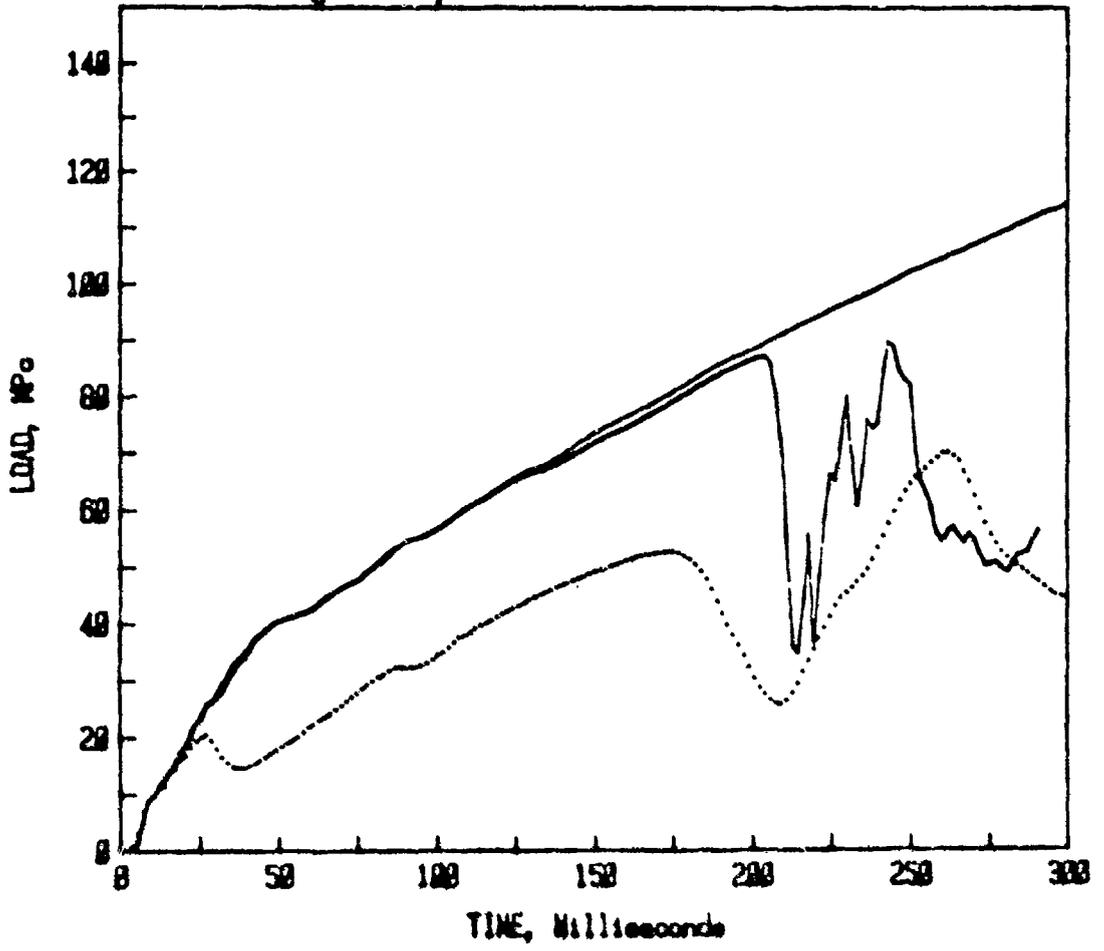


Figure 3f. Comp B10 (60/30/10)

Rigid Body & RDX/TNT (60/40) vs Test

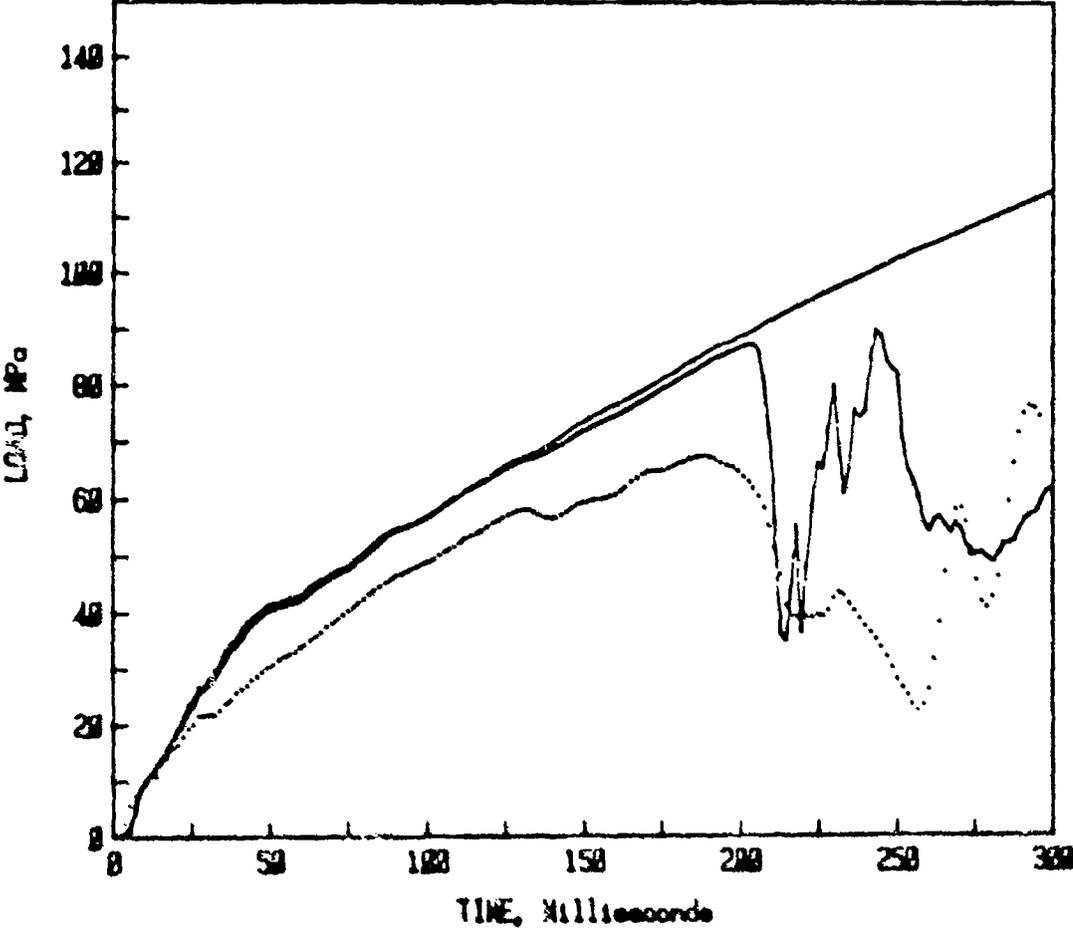


Figure 3m. Comp C10 (60/30/10)

Effect of Additives on the deformation of TNT Castings

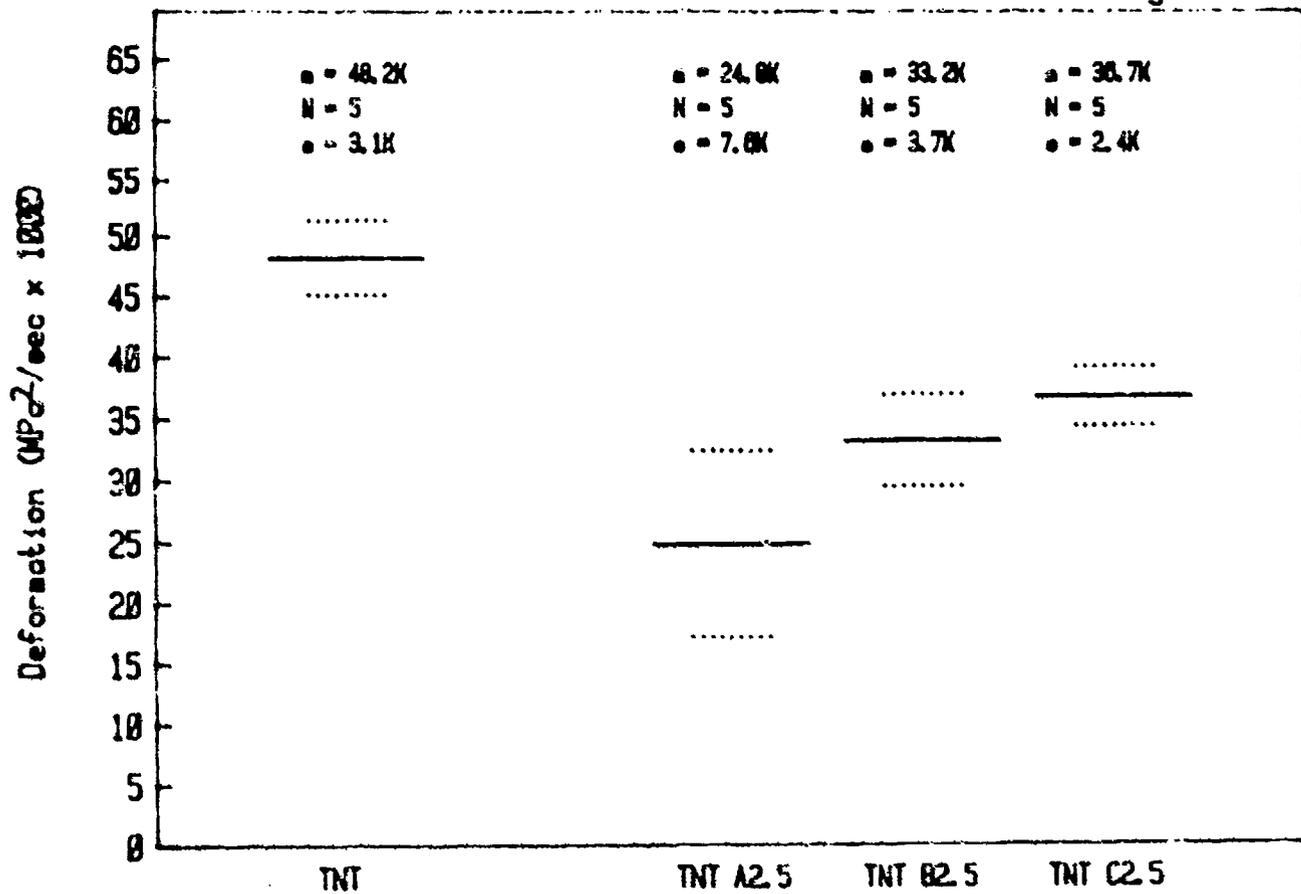


Figure 4a. 2.5% additives A, B, and C versus control (standard TNT)

Effect of Additives on the deformation of TNT Castings

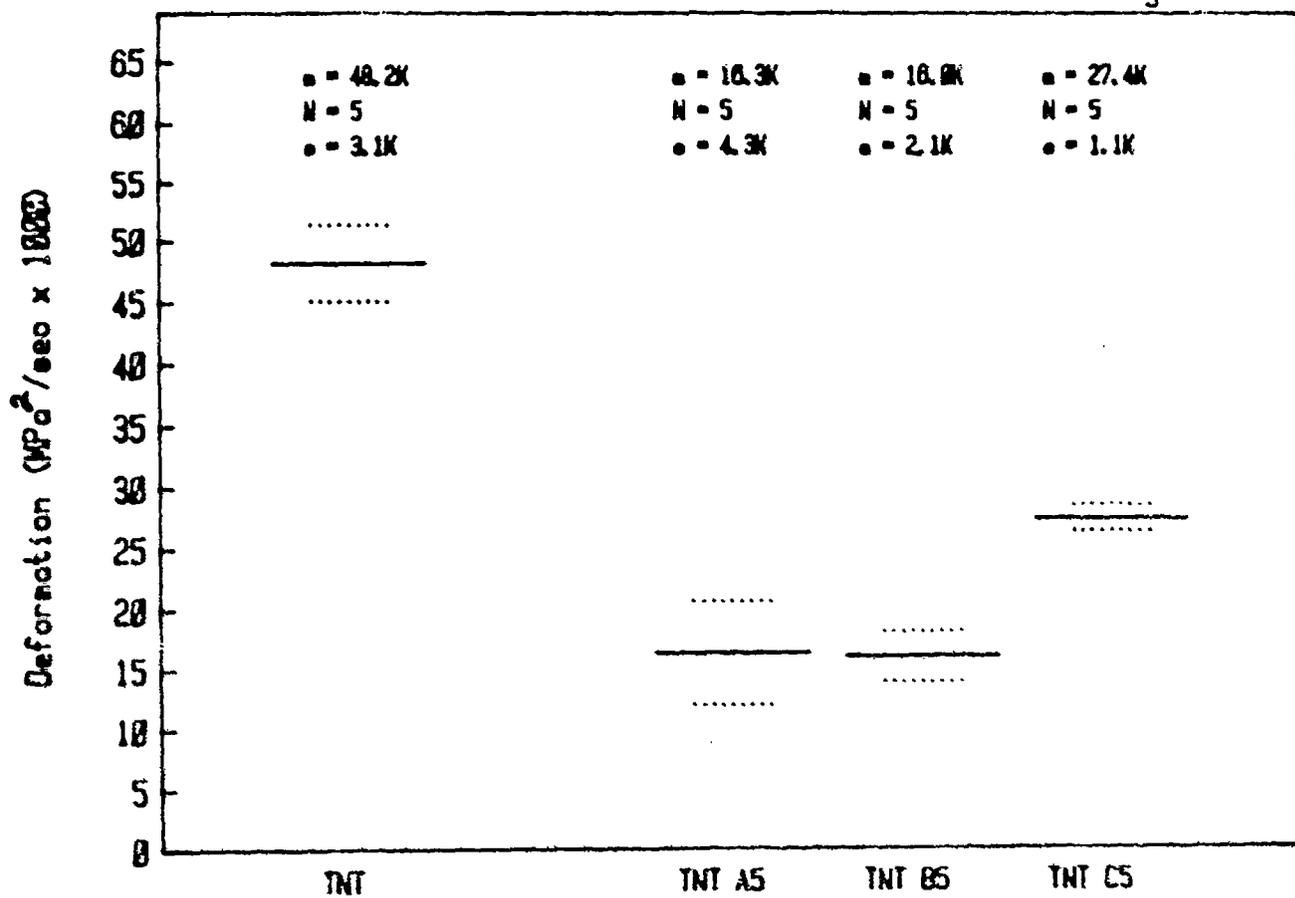


Figure 4b. 5% additives A, B, and C versus control (standard TNT)

Effect of Additives on the deformation of TNT Coatings

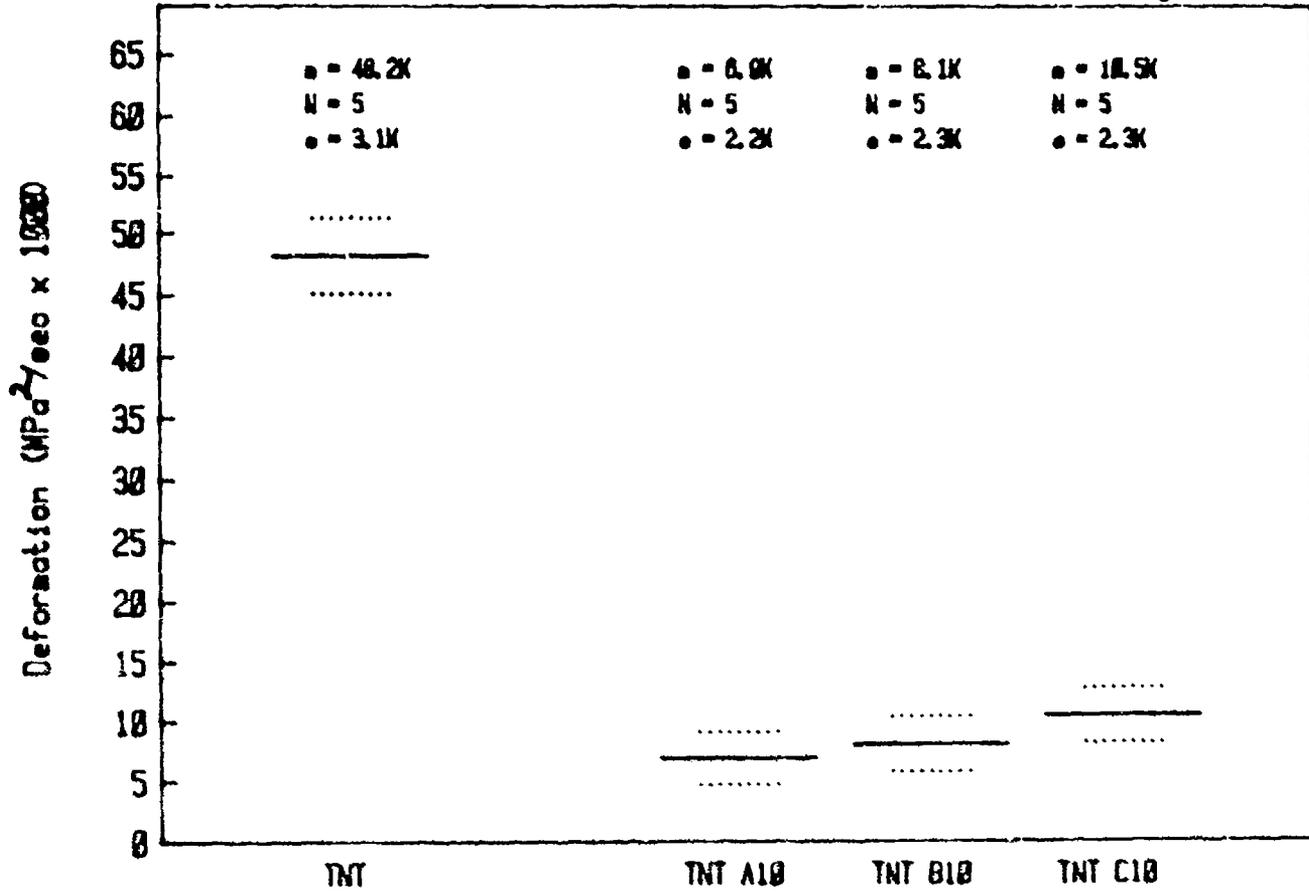


Figure 4c. 10% additives A, B, and C versus control (standard TNT)

Effect of Additives on the deformation of RDX/TNT Castings

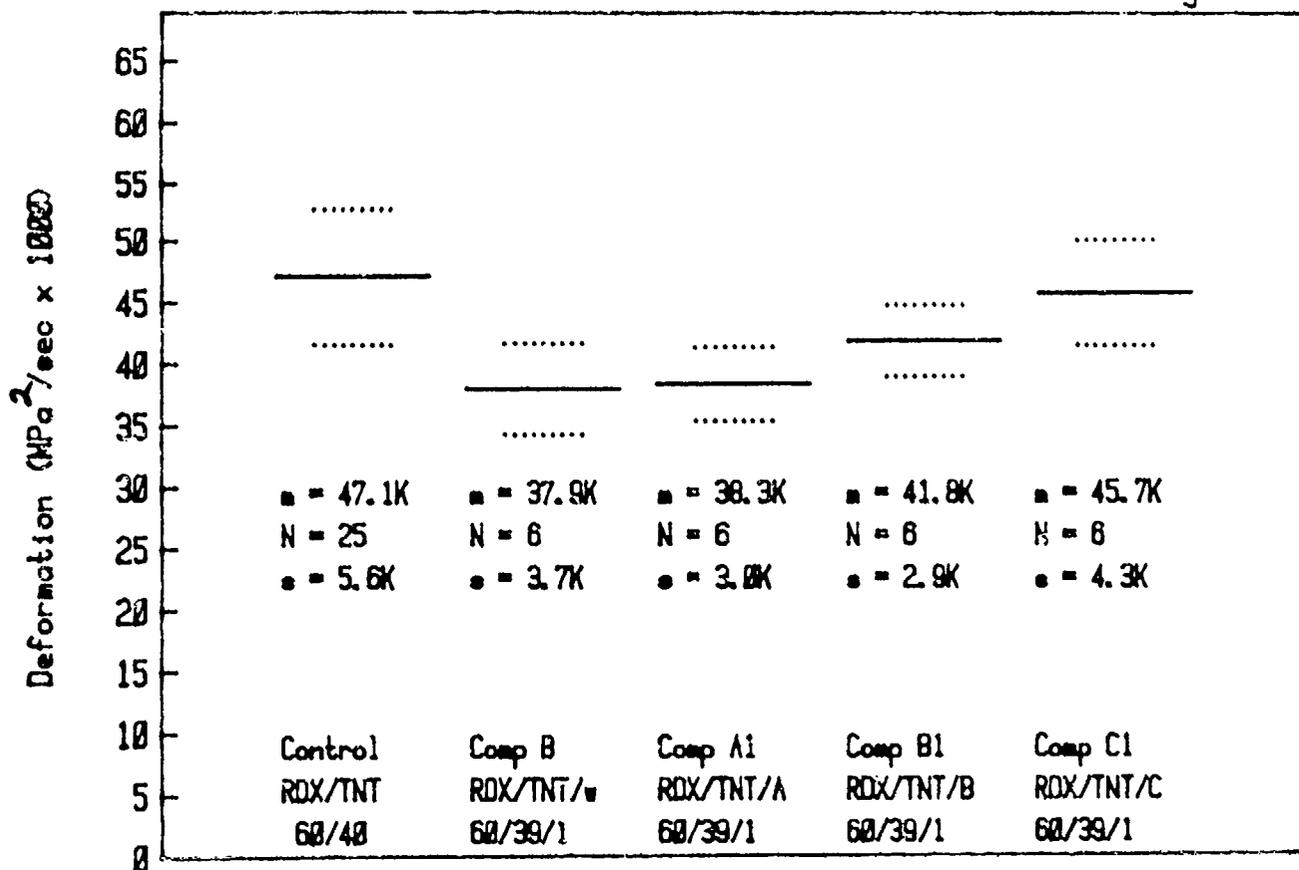


Figure 5a. 1% additive A, B, and C versus control and regular Comp B

Effect of Additives on the deformation of RDX/TNT Castings

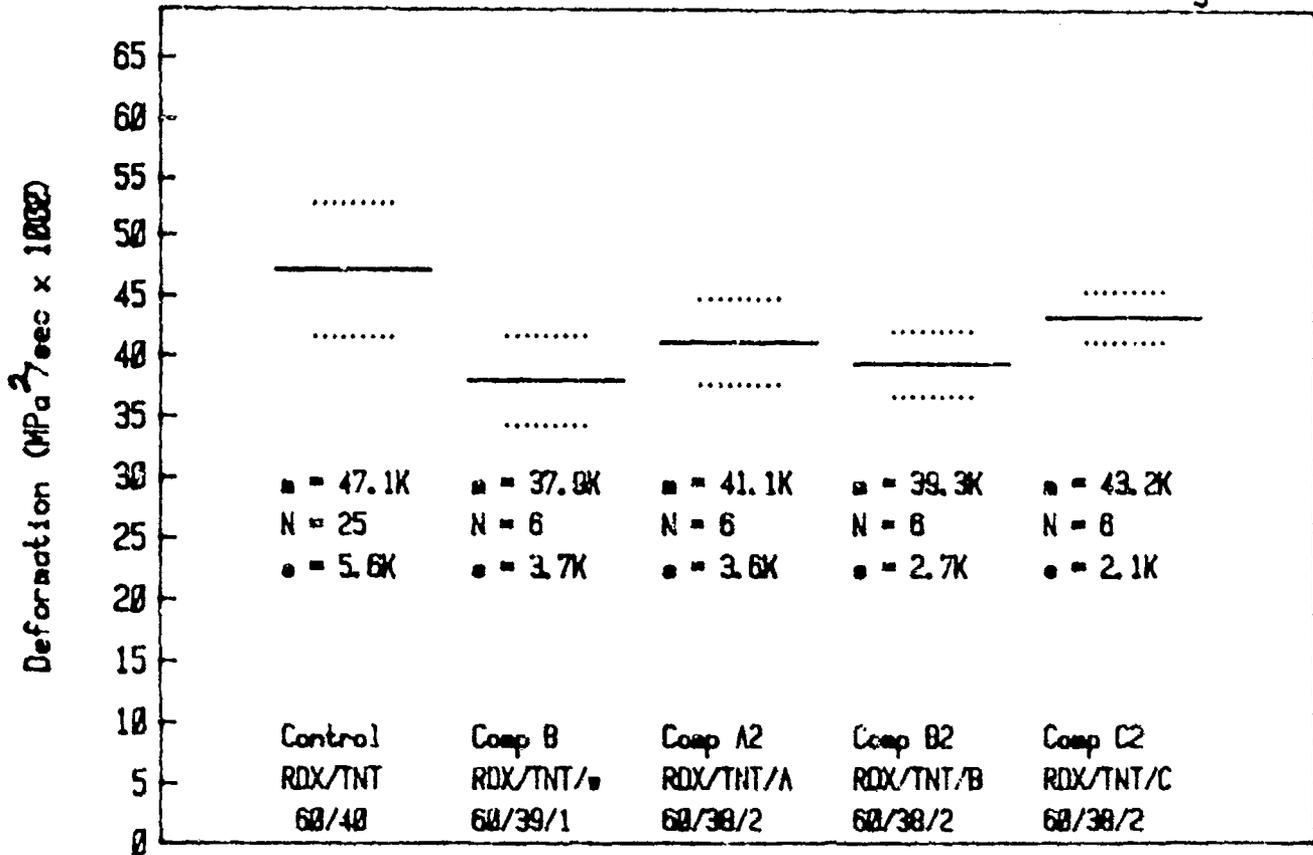


Figure 5b. 2% additives A, B, and C versus control and regular Comp B

Effect of Additives on the deformation of RDX/TNT Castings

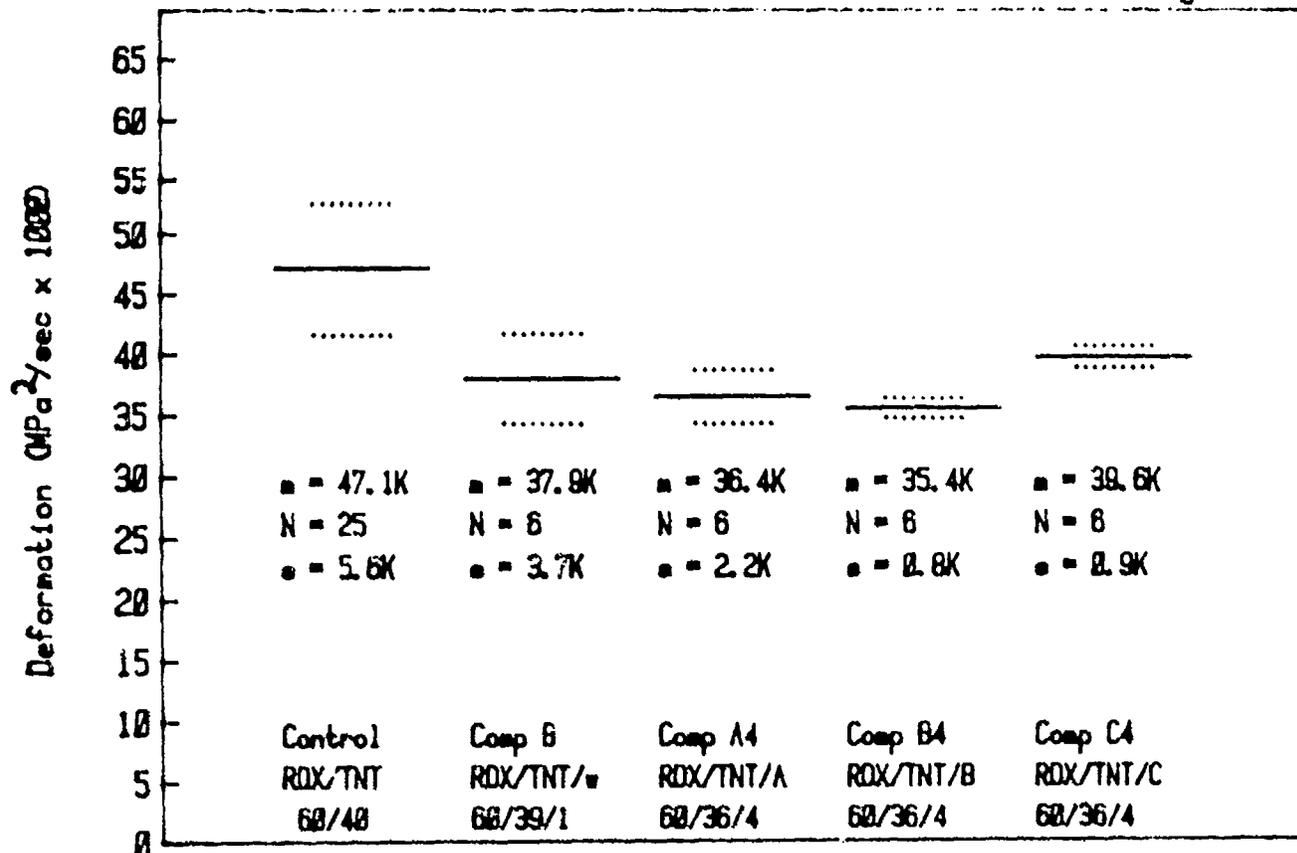


Figure 5c. 4% additives A, B, and C versus control and regular Comp B

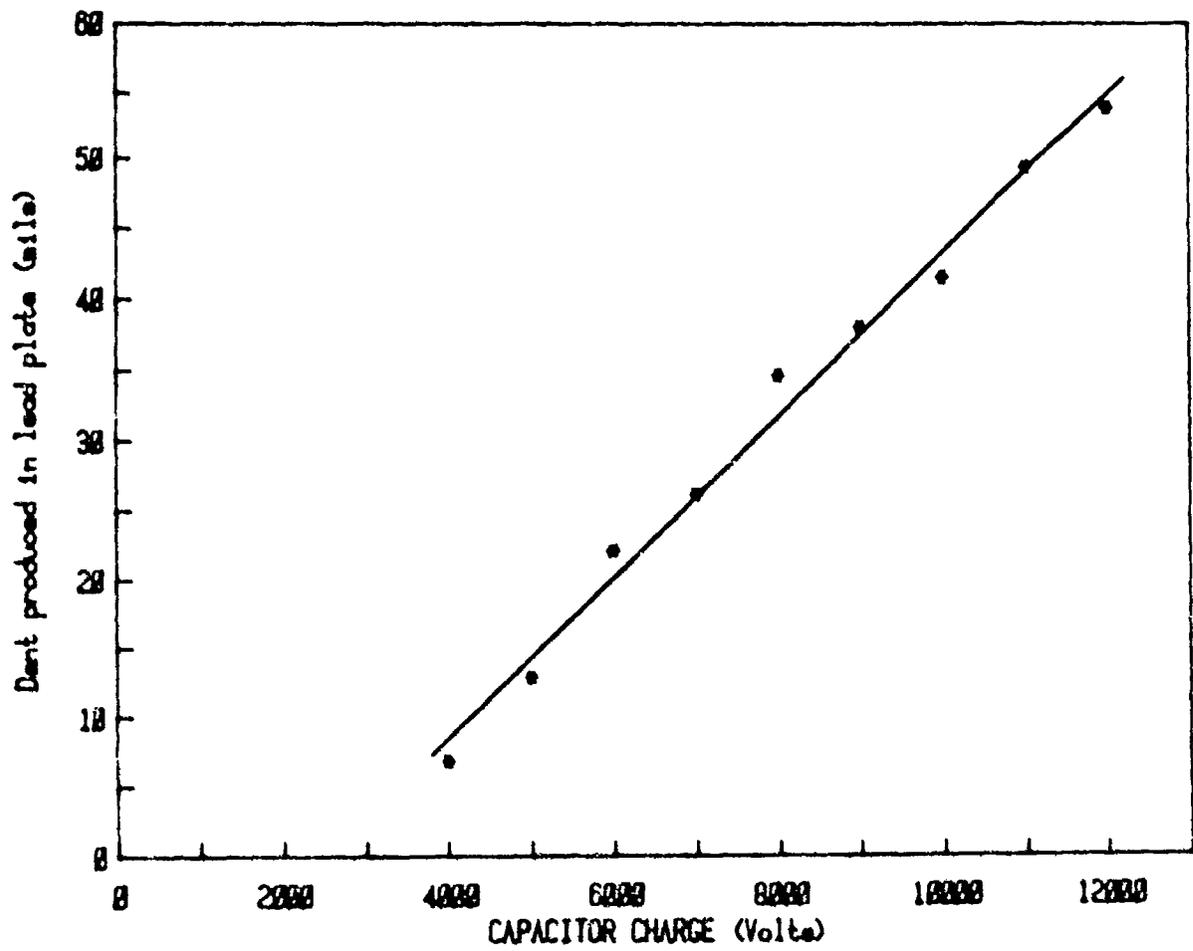


Figure 6. Validation of the slapper test concept

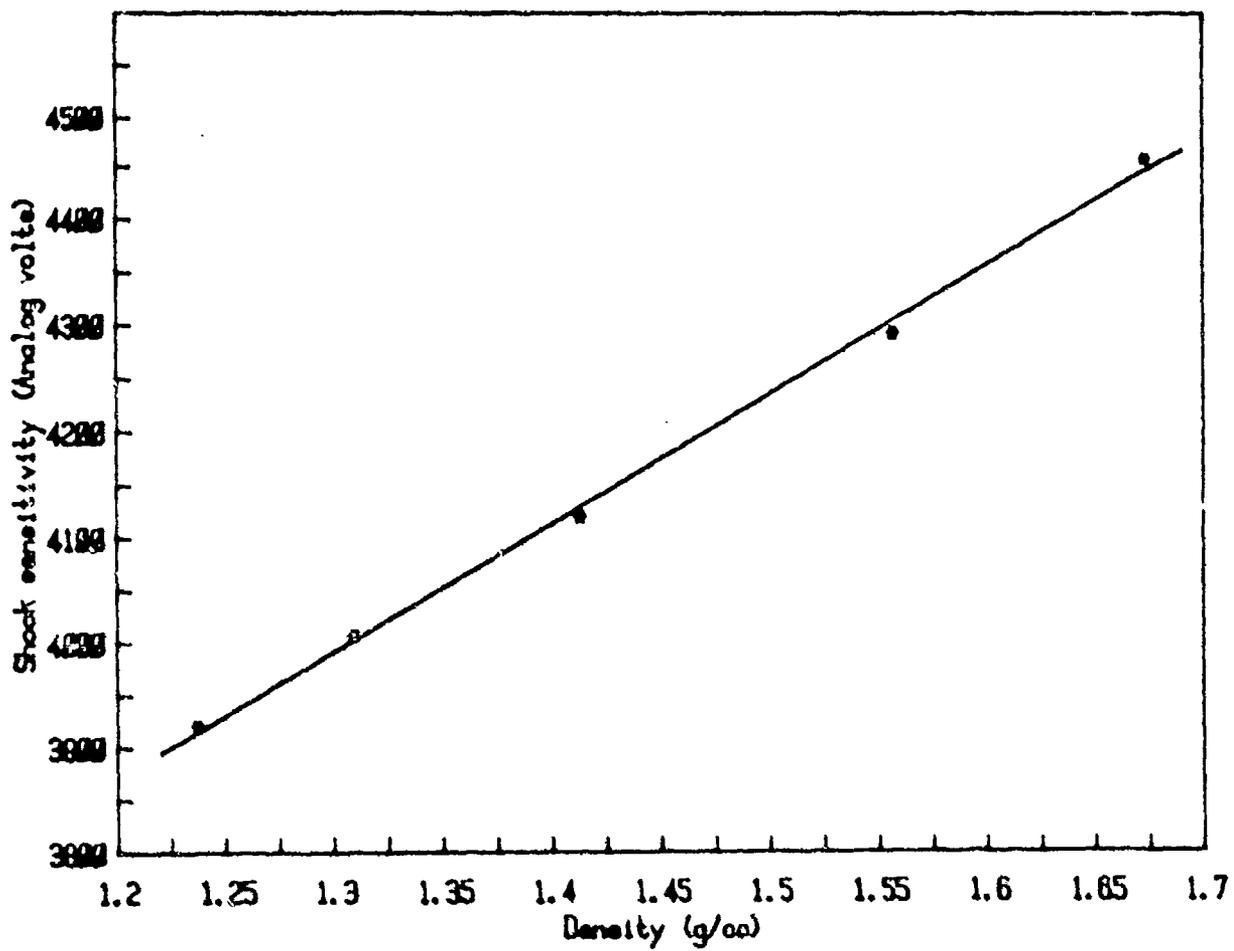


Figure 7. Density versus shock sensitivity for 5 u RDX

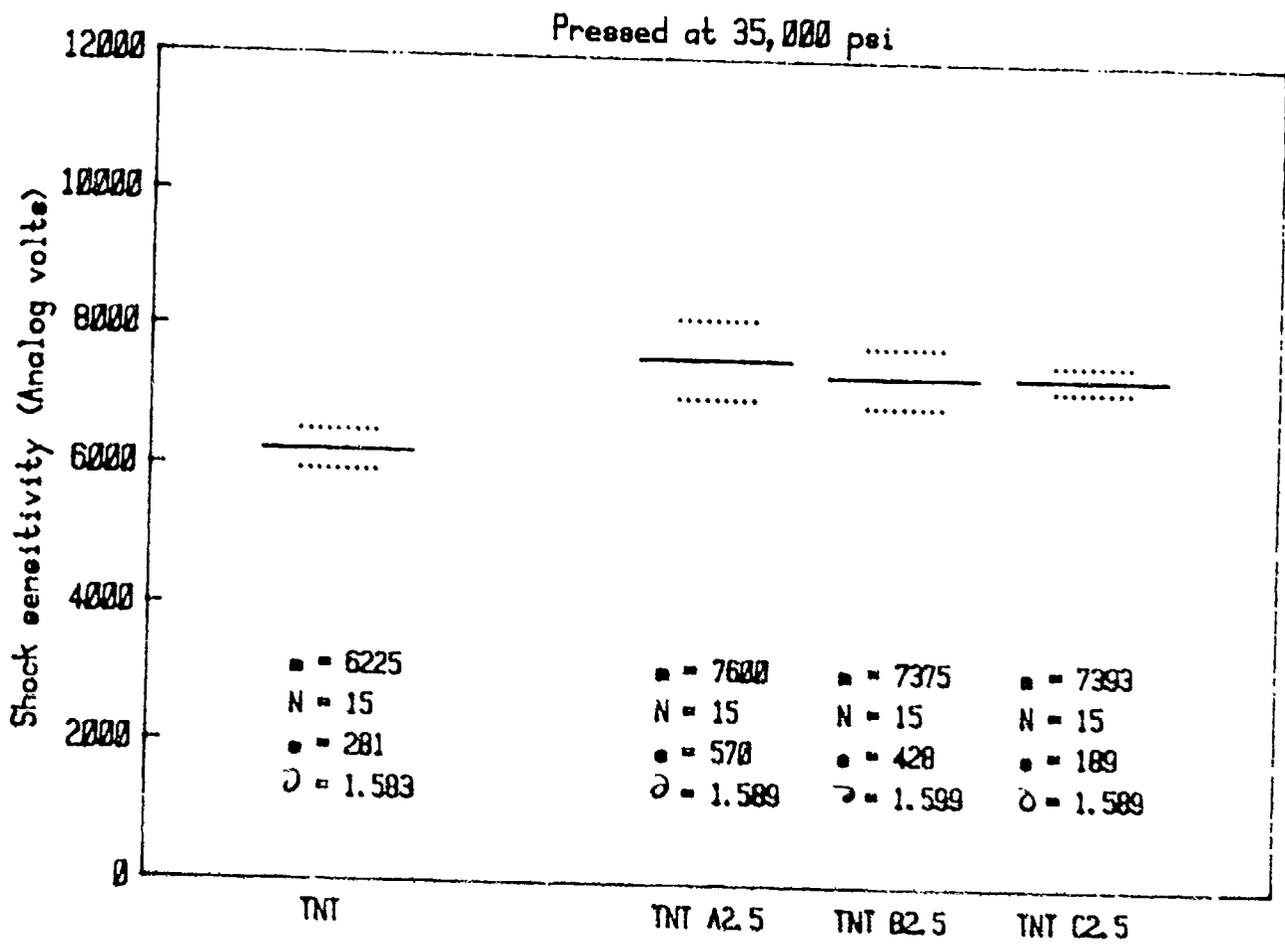


Figure 8a. 2.5% additives A, B, and C versus control (standard TNT)

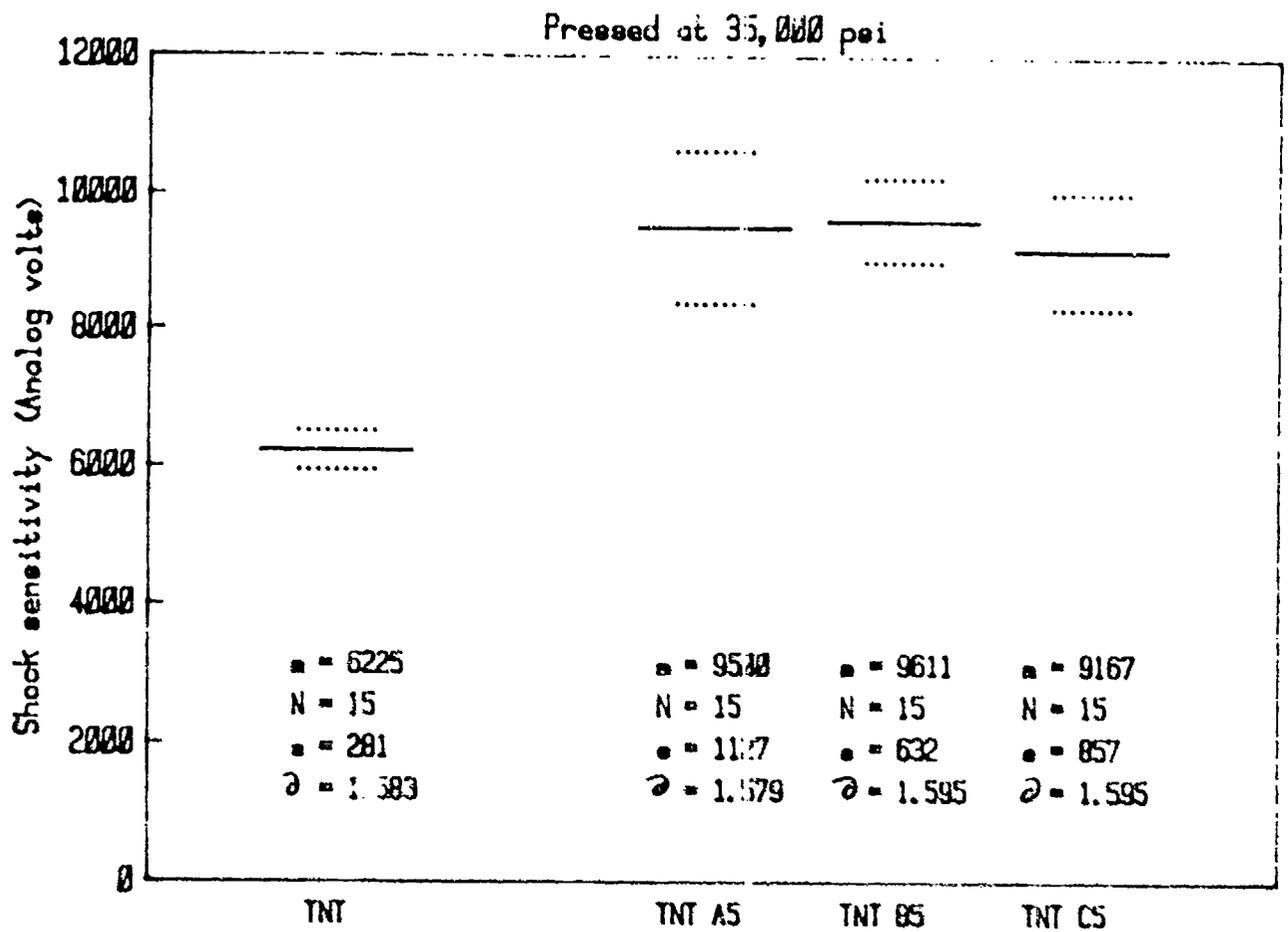


Figure 8b. 5% additives A, B, and C versus control (standard TNT)

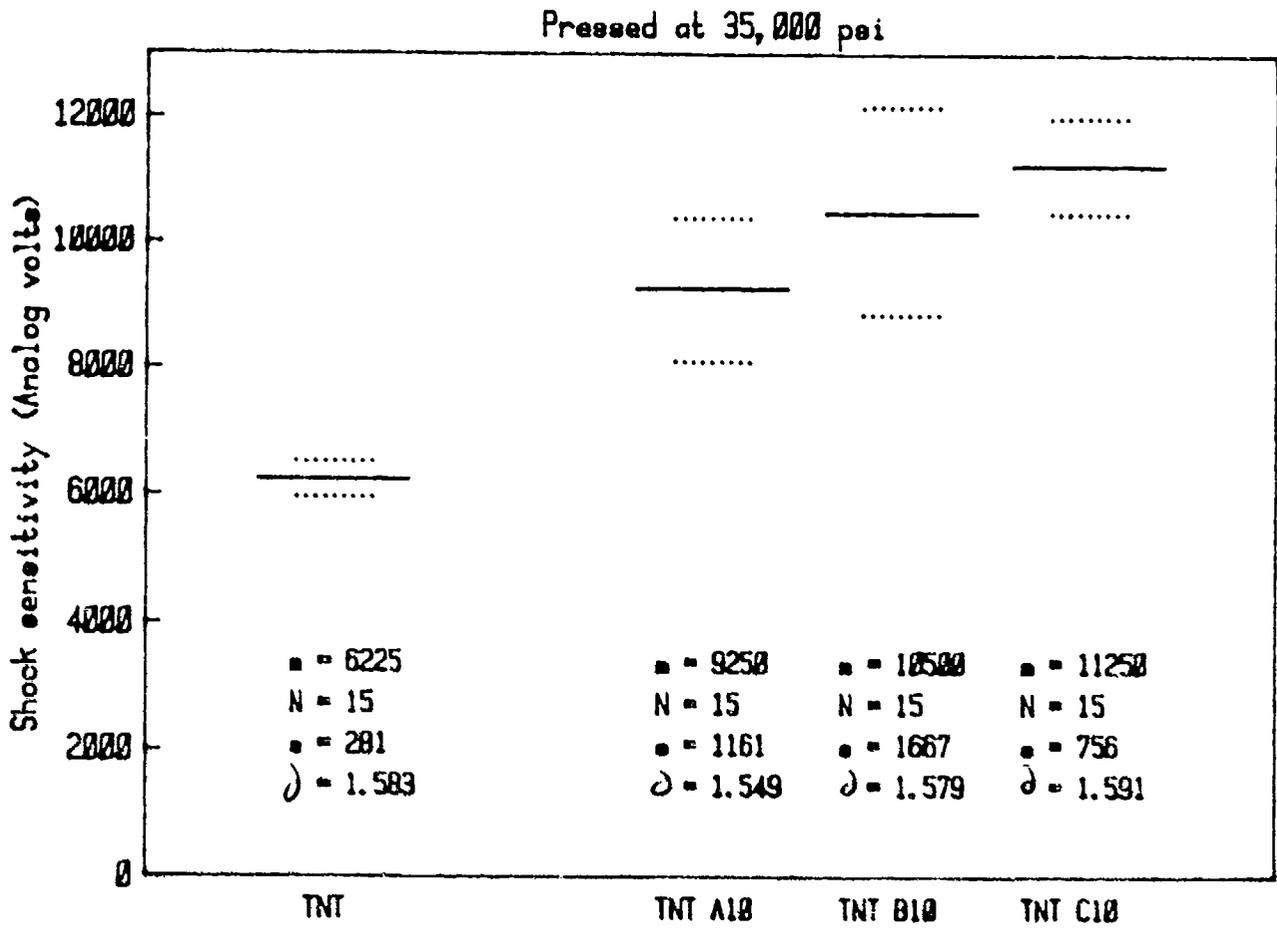


Figure 8c. 10% additives A, B, and C versus control (standard TNT)

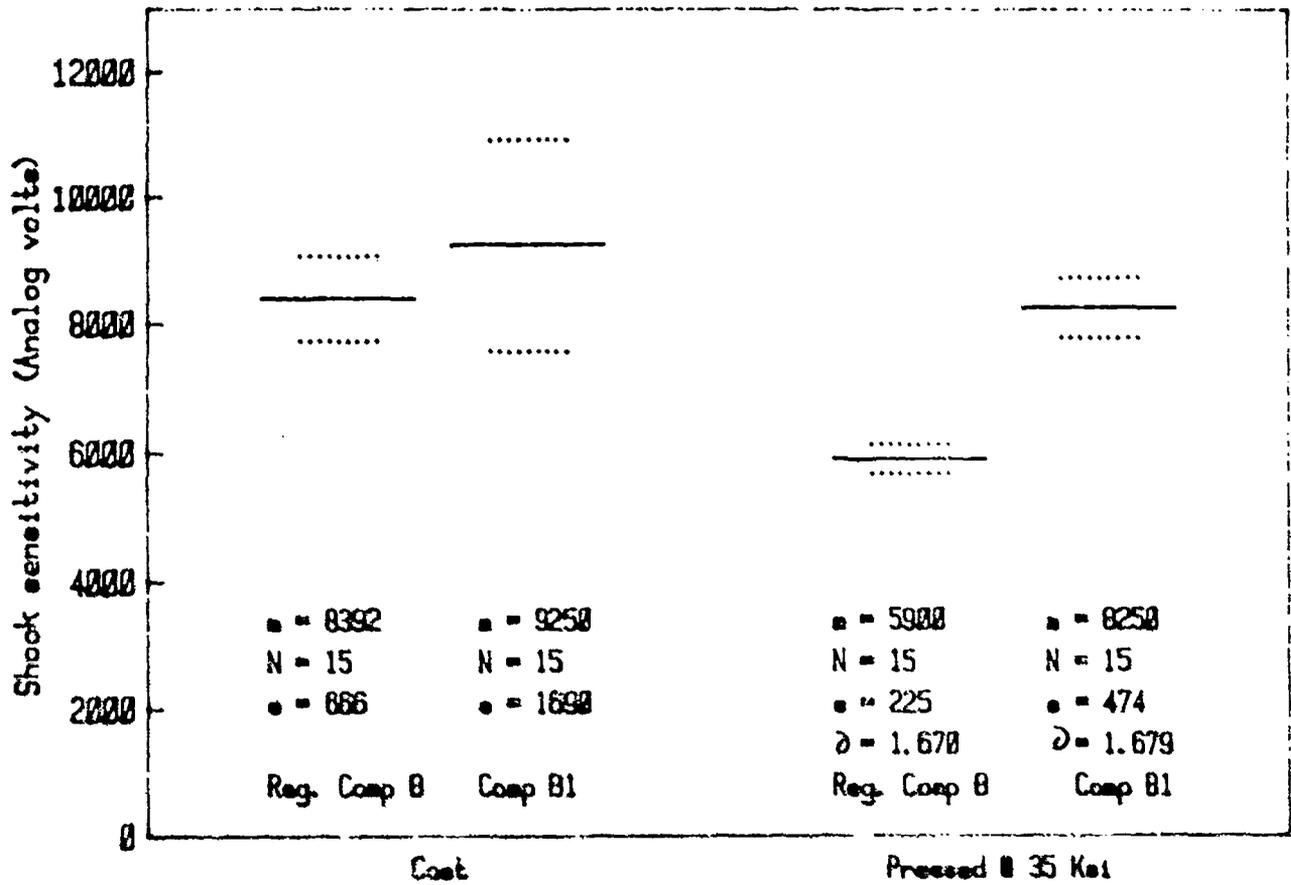


Figure 9. Shock sensitivity of Comp B1 versus regular Comp B

REFERENCES

1. Velicky, R. W.; Voigt, H. W.; and Nicolaidis, S., A Holistic Approach Directed Toward Controlling Inbore Explosions with Composition B, International Conference of ICT, Karlsruhe, West Germany, July 1988.
2. Velicky, R. W.; Voigt, H. W.; and Nicolaidis, S., "A Holistic Approach Directed Toward Controlling the Inbore Deflagration Hazard of Composition B, a Cast Explosive," Technical Report ARAED-TR-88011, ARDEC, Picatinny Arsenal, NJ, August 1988.
3. Machacek, O.; Marrello, M. L.; Eck, G. R.; and Velicky, R. W., "Effect of Chlorowaxes on Sensitivity of Comp B," ARDEC Contractor Report ARAED-CR-87015, ARDEC, Picatinny Arsenal, NJ, Jun 1987.
4. Velicky, R. W., "The Burning Behavior of TNT in the Closed Bomb," Journal of Energetic Materials, vol 1, pp 177-205, 1983.
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6. Voreck, W. and Velicky, R. W., Exploding Foil Shock Sensitivity Test, The Seventh Symposium (International) on Detonation, Annapolis, MD, July, 1981.
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8. Velicky, R. W., "A Method to Evaluate the Burning Behavior of Secondary Explosives - Composition B," ARLCD-TR-83030, ARRADCOM, Dover, NJ, June 1983.
9. Velicky, R. W.; Voigt, W.; and Voreck, W., The Effect of Some Additives on the Closed Bomb Burning and Ignitability of RDX/TNT (60/40), The Eighth Symposium (International) on Detonation, Albuquerque, NM, July 1985.

APPENDIX
MATERIAL SAFETY DATA SHEET FOR CHLOROWAX

OCCIDENTAL CHEMICAL MATERIAL SAFETY DATA SHEET

MSDS NUMBER. M1204

MSDS DATE: 11-06-86

PRODUCT NAME. **CHLOROWAX 45LV**

24 HOUR EMERGENCY PHONE: (716) 278-7021

I. PRODUCT IDENTIFICATION

1 HEALTH HAZARD, 1 FIRE HAZARD, & 0 REACTIVITY rating based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

MANUFACTURER'S NAME AND ADDRESS. Occidental Chemical Customer Service Center, 545 East John Carpenter Freeway, Suite 1020, Irving, Texas 75062 (Telephone 1-800-752-5151)

CHEMICAL NAME: Chlorinated Paraffin CAS NUMBER: 61788-76-9

SYNONYMS/Common Names: Liquid Chlorinated Paraffin

CHEMICAL FORMULA: $C_{12}H_{23}Cl_3$ (Typical)

DOT PROPER SHIPPING NAME. NA

DOT HAZARD CLASS: NA

DOT I.D. NUMBER: NA HAZARDOUS SUBSTANCE. NA

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	HAZARD DATA	CAS NUMBER	%
Chlorinated Paraffin	PEL = None Established TLV = None Established (See Section V)	61788-76-9	100

The material in this product is listed in the TSCA Inventory. Not listed as carcinogenic by IARC, NTP, OSHA, ACGIH. See Section V.

III. PHYSICAL DATA

BOILING POINT @ 760 mm Hg. N/A product decomposes above 204°C

MELTING POINT. Pour Point -65°F % VOLATILES BY VOL. N/A

VAPOR PRESSURE N/A DENSITY AT 20°C. 1.35 gm/cc

EVAPORATION RATE (BuAc=1). NA VAPOR DENSITY (Air=1). N/A

SPECIFIC GRAVITY (H₂O=1) 1.098 @ 25°C

SOLUBILITY IN H₂O % BY WT Negligible

APPEARANCE AND ODOR Clear-to-light amber liquid with a slight odor

pH NA

CAS - Chemical Abstract Service Number
PEL - OSHA Permissible Exposure Limit
TLV - ACGIH Threshold Limit Value - Current

ND - No relevant information found or not available
NA - Not applicable
CCLEP - Corporate Exposure Limit

IMPORTANT: The information presented herein, while not guaranteed, was prepared by competent technical personnel and is true and accurate to the best of our knowledge. NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, IS MADE REGARDING PERFORMANCE, STABILITY OR OTHERWISE. This information is not intended to be all inclusive as to the manner and conditions of use, handling and storage. Other factors may involve other or additional safety or performance considerations. While our technical personnel will be happy to respond to questions regarding safe handling and use procedures, safe handling and use remains the responsibility of the customer. No suggestions for use are intended as, and nothing herein shall be construed as a recommendation to infringe any existing patents or violate any Federal, State or local laws.

IV. FIRE AND EXPLOSION DATA

FLASH POINT: None under 204°C AUTOIGNITION TEMPERATURE: N/A
FLAMMABLE LIMITS IN AIR, % BY VOLUME- UPPER: Nonflammable
LOWER: Nonflammable

EXTINGUISHING MEDIA: Fires involving this product are unlikely, but should one occur, it may be controlled by carbon dioxide, dry chemicals, foam, or water fog.

SPECIAL FIRE FIGHTING PROCEDURES: Pressure-demand, self-contained breathing apparatus should be provided for fire fighters in buildings or confined areas where this product is stored. This product at high temperatures, releases hydrogen chloride gas. Storage containers exposed to fire should be kept cool with water spray in order to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARD: This product is nonflammable and nonexplosive under normal conditions of use. Over-pressurization of containers will also occur if exposed to excessive heat. This product flows freely when hot and should, therefore, be treated as an oil when exposed in a fire.

V. HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA: Chlorinated paraffins are a class of compounds that are similarly manufactured, but vary in molecular structure by carbon chain length and degree of chlorination.

The National Toxicology Program (NTP) has reported that in recent studies a C₁₂, 59% chlorinated paraffin in combination with corn oil caused tumors when forced fed at very high doses to rats and mice over long periods of time. The NTP also reported that a C₂₄, 43% chlorinated paraffin under the same conditions caused an increase in tumors only in male mice.

ROUTES OF EXPOSURE

INHALATION Under normal use conditions, this product is nontoxic, however, under significant decomposition conditions, mild-to-moderate irritation of the upper respiratory tract can occur due to evolution of hydrogen chloride gas.

SKIN CONTACT May produce mild irritation which is readily reversible. Not known to be a sensitizer.

SKIN ABSORPTION Not readily absorbed through skin.

EYE CONTACT May produce mild transient irritation.

INGESTION Not expected to produce toxic effects when ingested.

EFFECTS OF OVEREXPOSURE

ACUTE May produce mild, reversible skin and eye irritation.

CHRONIC The toxicity profile would suggest a slight hazard to those chronically exposed to this product. The liver is the probable target organ, should massive systemic poisoning occur.

EMERGENCY AND FIRST AID PROCEDURES

EYES OBJECT IS TO FLUSH MATERIAL OUT, THEN SEEK MEDICAL ATTENTION. IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire eye surface. Seek medical attention.

SKIN Wash contaminated areas with soap and water. Do not use solvents for cleaning.

INHALATION Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

INGESTION NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

NOTES TO PHYSICIAN No skin sensitization is associated with the handling of this product.

VI. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY. Elevated temperatures and strong alkalis will promote the decomposition of this product. The thermal decomposition is a time/temperature relationship. At normal room temperatures, decomposition is virtually nil. At temperatures above 315°C, decomposition is rapid with resultant discoloration and hydrogen chloride release. This decomposition does not present any fire or explosive hazard.

INCOMPATIBILITY. This product will deteriorate with subsequent darkening and eventual decomposition when exposed to elevated temperatures or strong alkalis. The presence of iron or zinc in any form will catalyze this deterioration.

HAZARDOUS DECOMPOSITION PRODUCTS. Under fire conditions, this product will decompose to give off hydrogen chloride gas and traces of fragmented short-chain hydrocarbons. Under these conditions, sufficient hydrogen chloride is given off to necessitate the use of self-contained breathing apparatus. Held at 175°C for 4 hours, this product will give off a maximum of 0.5 weight percent hydrogen chloride.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION. Not known to polymerize.

VII. ENVIRONMENTAL PROCEDURES

SPILLS OR RELEASES. If material is spilled or released to the atmosphere, steps should be taken to contain liquids and prevent discharges to streams or sewer systems, and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.

DISPOSAL OR STORAGE. Clean-up action should be carefully planned and executed. Shipment, storage, and/or disposal of waste materials are regulated and action to handle spilled or released materials must meet the applicable rules. If any question exists, the appropriate agencies should be contacted to assure proper action being taken.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS. No special ventilation required under normal use. Use local exhaust ventilation where the product is heated or mist, spray, dust or vapor may be generated.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY Respiratory protection is not required under normal use. Use NIOSH/MSHA approved respiratory protection following manufacturer's recommendations where mist, spray, dust or vapor may be generated and where the product is heated.

EYE Face shield and goggles or chemical goggles should be worn where mist, spray or dust may be generated or where the product is heated.

GLOVES Impervious gloves should be worn. Cotton gloves have been recommended.

OTHER CLOTHING AND EQUIPMENT Standard work clothing. Standard work shoes. Shoes that can not be decontaminated should be discarded. Wash contaminated clothing with soap and water and dry before reuse. Shower and eyewash facilities should be accessible.

MONITORING EXPOSURE

BIOLOGICAL No applicable methods.

PERSONAL AREA Procedures applicable to total dust or mist can measure exposure, the low vapor pressure minimizes loss during sampling.

IX. SPECIAL PRECAUTIONS

SIGNAL WORD: WARNING

STATEMENT OF HAZARDS:
MAY CAUSE IRRITATION

PRECAUTIONARY STATEMENTS:

Avoid contact with eyes, skin, and clothing.

Wash thoroughly after handling.

Do not take internally.

KEEP OUT OF REACH OF CHILDREN.

See the Material Safety Data Sheet for more detailed information on safe handling.

FIRST AID:

IN CASE OF CONTACT:

For eyes: Immediately flush with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of entire eye surface. If irritation persists, seek medical attention.

For skin: Wash with plenty of soap and water; remove contaminated clothing. If irritation persists, seek medical attention.

IF INHALED: Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

IF SWALLOWED: NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

IN CASE OF FIRE: Use pressure-demand, self-contained breathing apparatus as this product, at high temperatures, releases hydrogen chloride (HCl) gas.

IN CASE OF SPILL OR LEAK: Observe handling precautions. Leaks should be stopped. Spills should be contained, then cleaned up using vacuum truck or absorbent material and removed to approved waste disposal area.

STORAGE AND DISPOSAL

STORAGE: To prevent deterioration, with subsequent discoloration and possible decomposition with liberation of hydrogen chloride gas, storage temperatures for this product should not exceed 66°C.

DISPOSAL: Package, store, transport and dispose of all clean-up materials and any contaminated equipment in accordance with all applicable federal, state, and local health and environmental regulations. Shipments of waste materials may be subject to manifesting requirements per applicable regulations. Appropriate disposal will depend on the nature of the waste material and should be performed by competent and properly permitted contractors. Ensure that all responsible federal, state, and local agencies receive proper notification of disposal.

DO NOT SWALLOW. FOR INDUSTRIAL USE ONLY. READ TECHNICAL DATA BULLETIN AND MATERIAL SAFETY DATA SHEET ON THIS PRODUCT BEFORE USING

FOR INDUSTRIAL USE ONLY

LABEL 051386M1204

OCCIDENTAL CHEMICAL MATERIAL SAFETY DATA SHEET

MSDS NUMBER: M6566

MSDS DATE: 11-07-86

PRODUCT NAME: CHLOROWAX 57-60

24 HOUR EMERGENCY PHONE: (716) 278-7021

I. PRODUCT IDENTIFICATION

1 HEALTH HAZARD, 1 FIRE HAZARD, & 0 REACTIVITY rating based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

MANUFACTURER'S NAME AND ADDRESS: Occidental Chemical Customer Service Center, 545 East John Carpenter Freeway, Suite 1020, Irving, Texas 75062 (Telephone 1-800-752-5151)

CHEMICAL NAME: Chlorinated Paraffin CAS NUMBER: 61788-76-9

SYNONYMS/Common Names: Liquid Chlorinated Paraffin

CHEMICAL FORMULA: C₁₃H₂₂Cl₆ (Typical)

DOT PROPER SHIPPING NAME: NA

DOT HAZARD CLASS: NA

DOT I.D. NUMBER: NA HAZARDOUS SUBSTANCE: NA

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	HAZARD DATA	CAS NUMBER	%
Chlorinated Paraffin	PEL = None Established TLV = None Established (See Section V)	61788-76-9	100

The material in this product is listed in the TSCA Inventory. Not listed as carcinogenic by IARC, NTP, OSHA, ACGIH. See Section V.

III. PHYSICAL DATA

BOILING POINT @ 760 mm Hg.	N/A	VAPOR DENSITY (Air=1)	N/A
MELTING POINT	N/A	% VOLATILES BY VOL.	N/A
EVAPORATION RATE (BuAc=1)	N/A	DENSITY AT 20°C.	N/A
SOLUBILITY IN H ₂ O % BY WT.	Negligible	VAPOR PRESSURE	N/A
SPECIFIC GRAVITY (H ₂ O=1)	1.33 @ 25°C/25°C		
LIGHT STABILITY	Discolors in sunlight		
APPEARANCE AND ODOR	Clear-to-light amber liquid with a slight odor		
pH	NA		

CAS - Chemical Abstract Service Number
PEL - OSHA Permissible Exposure Limit
TLV - ACGIH Threshold Limit Value, Current

ND - No relevant information found or not available
NA - Not applicable
CORP - Corporate Exposure Limit

IMPORTANT: The information presented herein, while not guaranteed, was prepared by competent technical personnel and is true and accurate to the best of our knowledge. NO WARRANTY OR GUARANTEE EXPRESS OR IMPLIED IS MADE REGARDING PERFORMANCE, STABILITY OR OTHERWISE. This information is not intended to be all-inclusive as to the manner and conditions of use, handling and storage. Other factors may involve other or additional safety or performance considerations. While our technical personnel will be happy to respond to questions regarding safe handling and use procedures, safe handling and use remains the responsibility of the customer. No suggestions for use are intended as, and nothing herein shall be construed as a recommendation to infringe any existing patents or violate any Federal, State or local laws.

IV. FIRE AND EXPLOSION DATA

FLASH POINT: None under 204°C AUTOIGNITION TEMPERATURE: N/A
FLAMMABLE LIMITS IN AIR, % BY VOLUME- UPPER: Nonflammable
LOWER: Nonflammable

EXTINGUISHING MEDIA: Fires involving this product are unlikely, but should one occur, it may be controlled by carbon dioxide, dry chemicals, foam, or water fog.

SPECIAL FIRE FIGHTING PROCEDURES: Pressure-demand, self-contained breathing apparatus should be provided for fire fighters in buildings or confined areas where this product is stored. This product at high temperatures, releases hydrogen chloride gas. Storage containers exposed to fire should be kept cool with water spray in order to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARD: This product is nonflammable and nonexplosive under normal conditions of use. Over-pressurization of containers will also occur if exposed to excessive heat. This product flows freely when hot and should, therefore, be treated as an oil when exposed in a fire.

V. HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA: Chlorinated paraffins are a class of compounds that are similarly manufactured, but vary in molecular structure by carbon chain length and degree of chlorination.

The National Toxicology Program (NTP) has reported that in recent studies a C₁₂, 59% chlorinated paraffin in combination with corn oil caused tumors when force fed at very high doses to rats and mice over long periods of time. The NTP also reported that a C₂₄, 43% chlorinated paraffin under the same conditions caused an increase in tumors only in male mice.

ROUTES OF EXPOSURE

INHALATION. Under normal use conditions, this product is nontoxic, however, under significant decomposition conditions, mild-to-moderate irritation of the upper respiratory tract can occur due to evolution of hydrogen chloride gas.

SKIN CONTACT. May produce mild irritation which is readily reversible. Not known to be a sensitizer.

SKIN ABSORPTION. Not readily absorbed through skin.

EYE CONTACT. May produce mild transient irritation.

INGESTION. Not expected to produce toxic effects when ingested.

EFFECTS OF OVEREXPOSURE

ACUTE May produce mild, reversible skin and eye irritation

CHRONIC The toxicity profile would suggest a slight hazard to those chronically exposed to this product. The liver is the probable target organ, should massive systemic poisoning occur.

EMERGENCY AND FIRST AID PROCEDURES

EYES OBJECT IS TO FLUSH MATERIAL OUT, THEN SEEK MEDICAL ATTENTION. IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire eye surface. Seek medical attention.

SKIN Wash contaminated areas with soap and water. Do not use solvents for cleaning.

INHALATION Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

INGESTION NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

NOTES TO PHYSICIAN No skin sensitization is associated with the handling of this product.

VI. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY: Elevated temperatures and strong alkalis will promote the decomposition of this product. The thermal decomposition is a time/temperature relationship. At normal room temperatures, decomposition is virtually nil. At temperatures above 315°C, decomposition is rapid with resultant discoloration and hydrogen chloride release. This decomposition does not present any fire or explosive hazard.

INCOMPATIBILITY: This product will deteriorate with subsequent darkening and eventual decomposition when exposed to elevated temperatures or strong alkalis. The presence of iron or zinc in any form will catalyze this deterioration.

HAZARDOUS DECOMPOSITION PRODUCTS: Under fire conditions, this product will decompose to give off hydrogen chloride gas and traces of fragmented short-chain hydrocarbons. Under these conditions, sufficient hydrogen chloride is given off to necessitate the use of self-contained breathing apparatus. Held at 175°C for 4 hours, this product will give off a maximum of 0.5 weight percent hydrogen chloride.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION: Not known to polymerize.

VII. ENVIRONMENTAL PROCEDURES

SPILLS OR RELEASES: If material is spilled or released to the atmosphere, steps should be taken to contain liquids and prevent discharges to streams or sewer systems; and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.

DISPOSAL OR STORAGE: Clean-up action should be carefully planned and executed. Shipment, storage, and/or disposal of waste materials are regulated and action to handle spilled or released materials must meet the applicable rules. If any question exists, the appropriate agencies should be contacted to assure proper action being taken.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS. No special ventilation required under normal use. Use local exhaust ventilation where the product is heated or mist, spray, dust or vapor may be generated.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY. Respiratory protection is not required under normal use. Use NIOSH/MSHA approved respiratory protection following manufacturer's recommendations where mist, spray, dust or vapor may be generated and where the product is heated.

EYE. Face shield and goggles or chemical goggles should be worn where mist, spray or dust may be generated or where the product is heated.

GLOVES. Impervious gloves should be worn. Cotton gloves have been recommended.

OTHER CLOTHING AND EQUIPMENT. Standard work clothing. Standard work shoes. Shoes that can not be decontaminated should be discarded. Wash contaminated clothing with soap and water and dry before reuse. Shower and eyewash facilities should be accessible.

MONITORING EXPOSURE

BIOLOGICAL. No applicable methods.

PERSONAL/AREA. Procedures applicable to total dust or mist can measure exposure, the low vapor pressure minimizes loss during sampling.

IX. SPECIAL PRECAUTIONS

SIGNAL WORD: WARNING

STATEMENT OF HAZARDS:
MAY CAUSE IRRITATION

PRECAUTIONARY STATEMENTS:

Avoid contact with eyes, skin, and clothing.
Wash thoroughly after handling.
Do not take internally.

KEEP OUT OF REACH OF CHILDREN.

See the Material Safety Data Sheet for more detailed information on safe handling.

FIRST AID:

IN CASE OF CONTACT:

For eyes: Immediately flush with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of entire eye surface. If irritation persists, seek medical attention.

For skin: Wash with plenty of soap and water; remove contaminated clothing. If irritation persists, seek medical attention.

IF INHALED: Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

IF SWALLOWED: NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

IN CASE OF FIRE: Use pressure-demand, self-contained breathing apparatus as this product, at high temperatures, releases hydrogen chloride (HCl) gas.

IN CASE OF SPILL OR LEAK: Observe handling precautions. Leaks should be stopped. Spills should be contained, then cleaned up using vacuum truck or absorbent material and removed to approved waste disposal area.

STORAGE AND DISPOSAL

STORAGE To prevent deterioration, with subsequent discoloration and possible decomposition with liberation of hydrogen chloride gas, storage temperatures for this product should not exceed 66°C.

DISPOSAL Package, store, transport and dispose of all clean-up materials and any contaminated equipment in accordance with all applicable federal, state, and local health and environmental regulations. Shipments of waste materials may be subject to manifesting requirements per applicable regulations. Appropriate disposal will depend on the nature of the waste material and should be performed by competent and properly permitted contractors. Ensure that all responsible federal, state, and local agencies receive proper notification of disposal.

DO NOT SWALLOW FOR INDUSTRIAL USE ONLY READ TECHNICAL DATA BULLETIN AND MATERIAL SAFETY DATA SHEET ON THIS PRODUCT BEFORE USING.

FOR INDUSTRIAL USE ONLY

LABEL 061186M6566

OCCIDENTAL CHEMICAL MATERIAL SAFETY DATA SHEET

MSDS NUMBER: M1290

MSDS DATE: 11-06-86

PRODUCT NAME: **CHLOROWAX[®] 70-200**

24 HOUR EMERGENCY PHONE: (716) 278-7021

I. PRODUCT IDENTIFICATION

1 HEALTH HAZARD, 1 FIRE HAZARD, & 0 REACTIVITY rating based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

MANUFACTURER'S NAME AND ADDRESS: Occidental Chemical Customer Service Center, 545 East John Carpenter Freeway, Suite 1020, Irving, Texas 75062 (Telephone 1-800-752-5151)

CHEMICAL NAME: Chlorinated Paraffin CAS NUMBER: 61788-76-9

SYNONYMS/Common Names: Liquid Chlorinated Paraffin

CHEMICAL FORMULA: $C_{11}H_{14}Cl_{10}$ (Typical)

DOT PROPER SHIPPING NAME: NA

DOT HAZARD CLASS: NA

DOT I.D. NUMBER: NA HAZARDOUS SUBSTANCE: NA

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	HAZARD DATA	CAS NUMBER	%
Chlorinated Paraffin	PEL = None Established TLV = None Established (See Section V)	61788-76-9	100

The material in this product is listed in the TSCA Inventory. Not listed as carcinogenic by IARC, NTP, OSHA, ACGIH; See Section V.

III. PHYSICAL DATA

BOILING POINT @ 760 mm Hg.	N/A	VAPOR DENSITY (Air=1)	N/A
MELTING POINT	Pour Point, 16°C	% VOLATILES BY VOL.	N/A
VAPOR PRESSURE	N/A	DENSITY AT 20°C	N/A
EVAPORATION RATE (BuAc=1)	N/A	VISCOSITY, 200 SUS @ 90°C	
SPECIFIC GRAVITY (H ₂ O=1)	1.46 @ 25°C/25°C		
SOLUBILITY IN H ₂ O % BY WT	Negligible		
LIGHT STABILITY	Discolors in sunlight		
APPEARANCE AND ODOR	Light amber, very viscous liquid with slight odor		
pH	NA		

CAS = Chemical Abstract Service Number
PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value, Current

ND = No relevant information found or not available
NA = Not applicable
LEL = Corporate Exposure Limit

IMPORTANT: The information presented herein, while not guaranteed, was prepared by competent technical personnel and is true and accurate to the best of our knowledge. NO WARRANTY OR GUARANTEE EXPRESS OR IMPLIED IS MADE REGARDING PERFORMANCE, STABILITY OR OTHERWISE. This information is not intended to be all-inclusive as to the manner and conditions of use, handling and storage. Other factors may involve other or additional safety or performance considerations. While our technical personnel will be happy to respond to questions regarding safe handling and use procedures, safe handling and use remains the responsibility of the customer. No suggestions for use are intended as and nothing herein shall be construed as a recommendation to infringe any existing patents or violate any Federal, State or local laws.

IV. FIRE AND EXPLOSION DATA

FLASH POINT: None under 204°C
FLAMMABLE LIMITS IN AIR, % BY VOLUME- UPPER: Nonflammable
AUTIGNITION TEMPERATURE: N/A
LOWER: Nonflammable

EXTINGUISHING MEDIA: Fires involving this product are unlikely, but should one occur, it may be controlled by carbon dioxide, dry chemicals, foam, or water fog.

SPECIAL FIRE FIGHTING PROCEDURES: Pressure-demand, self-contained breathing apparatus should be provided for fire fighters in buildings or confined areas where this product is stored. This product at high temperatures, releases hydrogen chloride gas. Storage containers exposed to fire should be kept cool with water spray in order to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARD: This product is nonflammable and nonexplosive under normal conditions of use. Over-pressurization of containers will also occur if exposed to excessive heat. This product flows freely when hot and should, therefore, be treated as an oil when exposed in a fire.

V. HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA. Chlorinated paraffins are a class of compounds that are similarly manufactured, but vary in molecular structure by carbon chain length and degree of chlorination.

The National Toxicology Program (NTP) has reported that in recent studies a C₁₂, 59% chlorinated paraffin in combination with corn oil caused tumors when force fed at very high doses to rats and mice over long periods of time. The NTP also reported that a C₂₄, 43% chlorinated paraffin under the same conditions caused an increase in tumors only in male mice.

ROUTES OF EXPOSURE

INHALATION. Under normal use conditions, this product is nontoxic, however, under significant decomposition conditions, mild-to-moderate irritation of the upper respiratory tract can occur due to evolution of hydrogen chloride gas.

SKIN CONTACT. May produce mild irritation which is readily reversible. Not known to be a sensitizer.

SKIN ABSORPTION. Not readily absorbed through skin.

EYE CONTACT. May produce mild transient irritation.

INGESTION. Not expected to produce toxic effects when ingested.

EFFECTS OF OVEREXPOSURE

ACUTE. May produce mild, reversible skin and eye irritation

CHRONIC. The toxicity profile would suggest a slight hazard to those chronically exposed to this product. The liver is the probable target organ, should massive systemic poisoning occur

EMERGENCY AND FIRST AID PROCEDURES

EYES. OBJECT IS TO FLUSH MATERIAL OUT, THEN SEEK MEDICAL ATTENTION
IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire eye surface. Seek medical attention.

SKIN. Wash contaminated areas with soap and water. Do not use solvents for cleaning.

INHALATION. Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

INGESTION. NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

NOTES TO PHYSICIAN. No skin sensitization is associated with the handling of this product.

VI. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY: Elevated temperatures and strong alkalis will promote the decomposition of this product. The thermal decomposition is a time/temperature relationship. At normal room temperatures, decomposition is virtually nil. At temperatures above 315°C, decomposition is rapid with resultant discoloration and hydrogen chloride release. This decomposition does not present any fire or explosive hazard.

INCOMPATIBILITY: This product will deteriorate with subsequent darkening and eventual decomposition when exposed to elevated temperatures or strong alkalis. The presence of iron or zinc in any form will catalyze this deterioration.

HAZARDOUS DECOMPOSITION PRODUCTS: Under fire conditions, this product will decompose to give off hydrogen chloride gas and traces of fragmented short-chain hydrocarbons. Under these conditions, sufficient hydrogen chloride is given off to necessitate the use of self-contained breathing apparatus. Held at 175°C for 4 hours, this product will give off a maximum of 0.5 weight percent hydrogen chloride.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION: Not known to polymerize.

VII. ENVIRONMENTAL PROCEDURES

SPILLS OR RELEASES: If material is spilled or released to the atmosphere, steps should be taken to contain liquids and prevent discharges to streams or sewer systems; and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.

DISPOSAL OR STORAGE: Clean-up action should be carefully planned and executed. Shipment, storage, and/or disposal of waste materials are regulated and action to handle spilled or released materials must meet the applicable rules. If any question exists, the appropriate agencies should be contacted to assure proper action being taken.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS. No special ventilation required under normal use. Use local exhaust ventilation where the product is heated or mist, spray, dust or vapor may be generated

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY Respiratory protection is not required under normal use. Use NIOSH/MSHA approved respiratory protection following manufacturer's recommendations where mist, spray, dust or vapor may be generated and where the product is heated

EYE. Face shield and goggles or chemical goggles should be worn where mist, spray or dust may be generated or where the product is heated.

GLOVES. Impervious gloves should be worn. Cotton gloves have been recommended.

OTHER CLOTHING AND EQUIPMENT. Standard work clothing. Standard work shoes. Shoes that can not be decontaminated should be discarded. Wash contaminated clothing with soap and water and dry before reuse. Shower and eyewash facilities should be accessible.

MONITORING EXPOSURE

BIOLOGICAL No applicable methods

PERSONAL/AREA. Procedures applicable to total dust or mist can measure exposure, the low vapor pressure minimizes loss during sampling.

IX. SPECIAL PRECAUTIONS

SIGNAL WORD: WARNING!

STATEMENT OF HAZARDS:
MAY CAUSE IRRITATION

PRECAUTIONARY STATEMENTS:

Avoid contact with eyes, skin, and clothing.

Wash thoroughly after handling.

Do not take internally.

KEEP OUT OF REACH OF CHILDREN.

See the Material Safety Data Sheet for more detailed information on safe handling.

FIRST AID:

IN CASE OF CONTACT:

For eyes: Immediately flush with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of entire eye surface. If irritation persists, seek medical attention.

For skin: Wash with plenty of soap and water; remove contaminated clothing. If irritation persists, seek medical attention.

IF INHALED: Under fire conditions, get person out of contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen, if readily available. Seek medical attention immediately.

IF SWALLOWED: NEVER give anything by mouth to an unconscious person. If swallowed, DO NOT INDUCE VOMITING. If vomiting occurs spontaneously, keep airway clear. Seek medical attention immediately.

IN CASE OF FIRE: Use pressure-demand, self-contained breathing apparatus as this product, at high temperatures, releases hydrogen chloride (HCl) gas.

IN CASE OF SPILL OR LEAK: Observe handling precautions. Leaks should be stopped. Spills should be contained, then cleaned up using vacuum truck or absorbent material and removed to approved waste disposal area.

STORAGE AND DISPOSAL

STORAGE: To prevent deterioration, with subsequent discoloration and possible decomposition with liberation of hydrogen chloride gas, storage temperatures for this product should not exceed 66°C.

DISPOSAL: Package, store, transport and dispose of all clean-up materials and any contaminated equipment in accordance with all applicable federal, state, and local health and environmental regulations. Shipments of waste materials may be subject to manifesting requirements per applicable regulations. Appropriate disposal will depend on the nature of the waste material and should be performed by competent and properly permitted contractors. Ensure that all responsible federal, state, and local agencies receive proper notification of disposal.

DO NOT SWALLOW FOR INDUSTRIAL USE ONLY READ TECHNICAL DATA BULLETIN AND MATERIAL SAFETY DATA SHEET ON THIS PRODUCT BEFORE USING

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