

yel liq (acidic); bp 189–90°; d 1.258g/cc at 22°. Can be prepd from 1-chloro-1-nitropropane, K hydroxide and K nitrite (Ref 2). V sl sol in w, with an acidic reaction; sol in alkalis

1,1-Dinitropropane is an expl comparable in its power and sensitivity to TNT. Its thermal stability is satisfactory (does not expld to 360°; at 135°, acid in 30 mins, no expln in 300 mins) (Ref 2)

Q_V^0 3349cal/g, H₂O liq, or 3270, H₂O gas (Ref 3). Impact sensy 100cm+ with 2kg wt, BuMines app. One drop of the material was placed on a filter paper disc the same diameter as the striker of the app (Ref 4)

Refs: 1) Beil 1, 117 & [79] 2) Blatt, OSRD 2014 (1944) 3) L.E. Newman, PicArsnChem-Lab Rept No 1123718 (1948) 4) W. Anderson & H. Vaughan, *Ibid* 123975 (1948).

1,3-Dinitropropane. CH₂NO₂CH₂CH₂NO₂; colorl or pale yel oily liq; mp -21.4°; bp 103° at 1mm; d 1.353g/cc at 25.5°; RI 1.4638 at 25°. V sl sol in w, sol in eth

It was prepd by Keppler and Meyer (Ref 2) by treating 1,3-diiodopropane with Ag nitrate; the product obtained was very unstable. Urbański and Slón (Ref 3) later prepd it in small quantities, together with 1-nitropropane, on treating n-propane vapor with gaseous nitrogen. More recently, Kispersky et al (Ref 5) prepd a product from 1,3-diiodopropane and Ag nitrate which was stable for at least 9 months

Its Na compd, C₃H₅(NO₂)₂Na, was prepd by Keppler & Meyer (Ref 2), and was reported to be a violent expl ("heftig explodierendes pulver" in Ger)

Refs: 1) Beil 1, 117 & [79] 2) F. Keppler & V. Meyer, *Ber* 25, 1709–12 (1892) 3) T. Urbański & M. Slón, *CR* 203, 620–22 (1936) & *CA* 31, 653 (1937) 4) Blatt, OSRD 2014 (1944) 5) J.P. Kispersky, H.B. Hass & D.E. Holcomb, *JACS* 71, 516 (1949) & *CA* 43, 3352 (1951)

2,2-Dinitropropane. CH₃C(NO₂)₂CH₃; white crysts with a camphor-like odor; mp 53° with subl; bp 185.5°; d 1.26g/cc; subl at RT. V sl sol in w and insol in alkalis. Was first prepd in 1876 by the oxidation of propylpseudonitrole, CH₃C(NO)(NO₂)CH₃, with chromic acid, or by simply heating it in air at 100° (Ref 2). Nef (Ref 3) prepd it, among other products, by treating Ag dinitroethane with methyl iodide

2,2-Dinitropropane is an expl comparable with Tetryl in power (123% TNT) and with TNT in impact sensitivity. Q_C 427.8kcal/mole. Initiation temp is 360° in 5 secs. It loses 5.6% by wt in the 75° International Test, and is efflorescent

Refs: 1) Beil 1, 117 & [79] 2) V. Meyer & J. Lecher, *Ann* 180, 145–52 (1876) 3) J.U. Nef, *Ann* 280, 285 (1894) 4) Blatt, OSRD 2014 (1944) 5) Urbański 1, 597 (1964)

1,3-Dinitro-2,2-Dimethylpropane. See under 2,2-Dimethyl-1,3-dinitropropane or Dinitroneopropane in Vol 5, D1368-R

Propanediols and Derivatives

1,2-Propanediol (1,2-Propylene glycol, 1,2-Dihydroxypropane, Methyl glycol).

CH₃.CHOH.CH₂OH; mw 76.09; colorl, viscous, stable, hydr liq; bp 187.3°, d 1.0381g/cc at 20/20°; RI 1.4293 at 27°; fl pt (open cup) 210°F; autoignition temp 780°F. Misc with w, alcs, and many org solvents in all proportions. Can be prepd by hydration of propylene oxide. On nitration it yields the expl 1,2-Propanediol Dinitrate (see below)

Refs: 1) Beil 1, 472, (245) & [535] 2) *CondChemDict* (1971), 735-L 3) Merck (1976), 7649-L (No 7644)

1,2-Propanediol Dinitrate (Methyl Glycol Dinitrate). CH₃.CH(ONO₂).CH₂ONO₂; mw 166.09; N 16.87%; OB to CO₂ -28.9%; colorl, oily liq; mp -42.5°; does not freeze at -20°; bp 92° at 10mm; d 1.3774g/cc at 20/4°; RI 1.42720 at 20°; viscosity in poise, 0.0465 (20°); dielectric const 26.80 (20°) (Refs 8 & 9)

1,2-Propanediol Dinitrate was prepd by L. Henry (Ref 2) by slowly pouring propylene oxide into cooled nitric acid, followed by the addition of concd sulfuric acid. Naoúm (Ref 5) nitrated 1,2-propylene glycol with 5p of mixed acid contg 40% nitric and 60% sulfuric acids at 20° to give, in 86% yield, a product with a nitrogen content of 16.5%. A mixed acid contg 47.5% nitric, 45.5% sulfuric and 7% w was used by Matignon et al (Ref 6) at 10°. By using a

10% excess of nitric acid, they achieved a yield of 91–93%

It is insol in w; sol in alc, eth or strong nitric acid; gelatinizes NC

As early as 1904, 1,2-Propanediol Dinitrate was proposed (Ref 3) as an additive to lower the freezing temp of NG, but its practical application on a large scale was hindered by lack of the raw material, propane-1,2-diol. It is only recently that the synthesis of glycol from ethylene led to the development of a method for producing methyl glycol from propylene via chlorohydrin. Even so, propylene-1,2-glycol is somewhat more expensive than glycols derived from ethylene (Ref 9)

1,2-Propanediol Dinitrate is a HE, the properties of which were detd by Barab (Ref 4), Naoúm (Ref 5) and the Hercules Powder Co (Ref 8):

Heat of Formation. 83.1kcal/mole

Heat of Explosion. 1109kcal/kg at const vol with H₂O gaseous

Power. 540ml or 92% NG by Trauzl Pb block test with w tamping

Sensitivity to Impact. Less sensitive than NG

Stability. 60 minutes+ in 71° KI test

Velocity of Detonation. 6885m/sec and 2000 m/sec (?), as detd in 10mm ID glass tubes with 1mm wall (Ref 8)

Volatility. 3.8% loss in wt at 35° of a 10g sample in a 60mm diam dish after 24 hrs; after 3 days, 4.1%

Note: A mixt consisting chiefly of 1,2-Propanediol Dinitrate, but contg varying amts of ethylene glycol dinitrate and butylene glycol dinitrate was marketed under the trade name *Nitrobyronel* (Ref 8)

Refs: 1) Beil 1, 473 2) L. Henry, AnnChim (Paris) [4], 27, 261 (1872) 3) H. Claessen, GerP 179789 (1904) 4) J. Barab, USP 1371215 (1921) 5) Naoúm, NG (1928), 236–37 6) C. Matignon, H. Moureau & M. Dode, MP 25, 176 (1932–33) 7) Davis (1943), 234 8) Blatt, OSRD 2014 (1944) 9) Urbański 2, 3, 4 & 157 (1965)

1,3-Propanediol (Trimethylene glycol, 1,3-Dihydroxypropane). CH₂OH.CH₂.CH₂OH; mw 76.09; colorl to pale yel, very visc, sweet liq; mp, freezes in a mixt of dry ice and eth; bp

210–12°; d 1.0597g/cc at 20/4°; RI 1.4398 at 20°. Misc with w, alc; insol in eth, benz or chl. Can be prepd by reduction of ethyl glycidate with LiAl hydride. On nitration it yields the expl 1,3-Propanedioldinitrate (see below) *Refs:* 1) Beil 1, 475 & (247) 2) Naoúm, NG (1928), 229 3) Merck (1976), 1246-R (No 9384)

1,3-Propanediol Dinitrate (Trimethyleneglycol Dinitrate). O₂NOCH₂.CH₂.CH₂ONO₂; mw 166.09; N 16.87%; OB to CO₂ –28.9%; nearly colorl oily liq with a slight aromatic odor; mp –38°; bp 108° at 10mm, decomp at about 185° with evolution of yel fumes and deflagrates at 225°; d 1.4053 at 16/16°, 1.3952 at 20/4°; RI 1.43476 at 20°; viscosity in poise, 0.0940 (6.3°), 0.0550 (20.2°), 0.0275 (54.2°); dielectric const 18.97 at 20°; dipole moment 3.50 (Ref 6)

Nearly insol in w, easily sol in alc, eth, et ac, benz; gelatinizes NC. Can be prepd by the nitration of 1,3-propanediol with mixed nitric-sulfuric acid, as described by Naoúm (Ref 4) and Blechta (Ref 3). The nitration requires a lower temp than that used for nitrating glycerin, because the central methylene group is readily oxidized at a higher temp. A temp between 0–10° is recommended since decompn is possible even at 15°, while at 20° yel fumes are evolved. Separating the product from the spent acid occurs with ease at 10°. From 100p of 1,3-propanediol, 198p of the dinitrate are produced corresponding to 90.6% of theoretical

1,3-Propanediol Dinitrate is a powerful and brisant expl which is less sensitive than NG, and has satisfactory stability. Following are some of its properties, as given in Refs 2, 3, 4, 5 & 6, and by the Hercules Powder Co:

Heat of Explosion. 1138.5kcal/kg (w as vapor)

Heat of Formation. 78.1kcal/mole

Power. 540ml or 92% NG by Trauzl Pb block test with w tamping

Sensitivity to Impact. Very low; a 2kg wt falling 100cm fails to initiate an expln

Stability. 45 minutes in 83° KI test. Storage at 75° for 25 days caused no decompn or development of acidity

Toxicity. Similar to that of NG

Velocity of Detonation. 6890m/sec and 2100 m/sec (?), as detd in 10mm ID glass tubes with

Imm wall

Volatility. 1.8% loss in wt at 35° of a 10g sample in a 60mm diam dish after 24 hrs; after 3 days, 4.2%

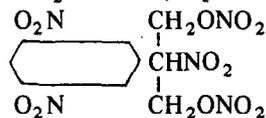
Notes: It was proposed for use as an antifreeze addition to Dynamites. A blasting gelatine consisting of 93% 1,3-Propanediol Dinitrate and 7% collodion cotton gave a Pb block expansion of 470ml, or about 80% of the effect produced by the same gelatine contg NG

1,3-Propanediol Dinitrate was present in NG prepd in Ger by nitrating synthetic glycerin, called *Protol*

Refs: 1) Beil – not found 2) J. Barab, USP 1371215 (1921) 3) F. Blechta, SS 17, 57–8 (1922) 4) Naoúm, NG (1928), 231–36 5) Davis (1943), 233–34 6) Urbański 2, 3, 4 & 155–57 (1965)

Propanedioldinitrate (Commercial). Barab (Ref 4) patented liq expls contg varying amts of 1,2- and 1,3-Propanediol Dinitrates. These mixts were claimed to be as powerful as, but less sensitive than NG. The product was examined by the US BuMines and found to make up a 40% straight Dynamite that compared favorably with 40% straight NG Dynamite
Ref: J. Barab, USP 1371215 (1921)

2-(3',5'-Dinitrophenyl)-2-Nitro-1,3-Propanediol Dinitrate. C₉H₇N₅O₁₂; mw 377; N 18.6%; OB to CO₂ –66.5%; mp 114–115°; d 1.70g/cc;



Q_c 1022.9cal/mole. Prepd by condensing phenylnitromethane with formaldehyde, and nitrating the product

Sensitivity. Slightly less sensitive than PETN
Power. 126% TNT by BalMort

Stability. Ignites at 360°; thermal stability at 135°: acid in 60 mins, no expln in 300 mins

Hygroscopicity. Gains 0.05% at 100% RH

Refs: 1) Beil – not found 2) Blatt, OSRD 2014 (1944)

1-Propanol (n-Propyl alcohol, Propylic alcohol,

Optal). CH₃CH₂CH₂OH; mw 60.09; liq; mp –127°; bp 97.2°; d 0.8053g/cc at 20/4°; misc with w, alc & eth. Available as a by-product of the reaction between CO and H₂

Ref: Merck (1976), 1016-L (No 7630)

Dinitropropanols. C₃H₅(NO₂)₂OH; mw 150.10; N 18.7%; OB to CO₂ –42.7%

2,2-Dinitro-1-Propanol. CH₃C(NO₂)₂CH₂OH; crystals; mp 88°. Can be prepd by the action of formaldehyde on 1,1-dinitroethane. It is an expl comparable in power to Tetryl and in sensitivity to TNT. It is slightly hygroscopic and fairly stable

Note: A eutectic mixt of the formal and acetal of 2,2-Dinitropropanol (**DNPAF**) is used as the plasticizer in a plastic-bonded expl (PBX-9501) contg 95 wt % HMX, 2.5% Estane as the plastic bonding agent, and 2.5% DNPAF. It is claimed to have an expl energy comparable to that of PBX-9404 [94% HMX, 3% NC & 3% tris-(β-chloroethyl) phosphate (CEF)], but possesses greater temp stability and significantly better handling safety [T.M. Benziger, USP 3778319 (1973)]

1,1-Dinitropropanol (Dinitroisopropyl alcohol). (O₂N)₂CH.CHOH.CH₃; colorl oil; bp, deflagrates on heating above 120°; d 1.33g/cc at 15/4°; RI 1.449 at 15°; sol in w (1 p in 5–6p). Can be prepd by treating its K salt with dil sulfuric acid. The K salt is prepd from K dinitromethane and acetaldehyde

Refs: 1) Beil 1, 366 2) Blatt, OSRD 2014 (1944)

1,3-Diazidoisopropyl Alcohol (1,3-Diazido-propanol-2). N₃.CH₂.CHOH.CH₂.N₃; mw 142.13; N 59.14%; colorl, odorless liq; bp 88–91° at 0.6mm; d 1.2687g/cc at 21/4°. Can be prepd by reacting 1,3-dichlorohydrin with Na azide on a steam bath for 12 days in the dark. It expls on impact, when ignited, or when in contact with concd sulfuric acid. Several explns were reported when attempting to det its nitrogen content by combustion

Refs: 1) Beil 1, (186) 2) J.C. Philip, JCS 101, 493–96 & 1866–71 (1912)

1,3-Dinitramino-2-Propanol Nitrate. C₃H₇N₅O₇;