

TITAN[®] 5000

Matrix Blend Series

Technical
Information



Description

The TITAN 5000 emulsion series has been specifically formulated with an inhibitor for use in reactive (sulphidic) ground conditions and should be used in accordance with procedures that are developed on a site basis and in consultation with Dyno Nobel and regulatory authorities.

TITAN 5000 Gassed Blends are emulsion rich, water resistant mixtures of TITAN 5000 emulsion and ANFO. As the emulsion content of the blend increases, the water resistance of the product increases. Gassed blends are pumped from a Mobile Processing Unit (MPU) through a loading hose to the bottom of wet blastholes. Pumped product ensures the minimum emulsion content required to retain product inhibition is maintained.

TITAN 5000 Heavy ANFO Blends contain TITAN 5000 emulsion and ANFO manufactured from porous ammonium nitrate prill (DETAPRILL[®]) and are designed for use in dry or dewatered blastholes of medium to large diameter. The suitability of Heavy ANFO blends for reactive ground conditions is limited and must be determined in consultation with Dyno Nobel and regulatory authorities.

Advantages

When used in accordance with the *AEISG Code of Practice: Elevated Temperature and Reactive Ground* and site procedures, TITAN 5000 may be used to minimise risks associated with blasting in elevated ground temperatures and reactive ground conditions.

Properties

| TITAN 5000 Blend | 5020 | 5030 | 5040 | 5050 | 5050G | 5060G | 5070G | 5000G |
|---|-------------|------|------|------|-------|-------|-------|-------|
| Emulsion % | 20 | 30 | 40 | 50 | 50 | 60 | 70 | 100 |
| Cup Density (avg g/cm ³) ^{1,2} | 0.98 | 1.10 | 1.26 | 1.31 | 1.15 | 1.15 | 1.15 | 1.15 |
| Min. Diameter (mm) | 102 | 102 | 127 | 200 | 102 | 102 | 102 | 102 |
| Energy (MJ/kg) ³ | 3.4 | 3.3 | 3.2 | 3.1 | 3.1 | 3.0 | 2.8 | 2.5 |
| VoD (m/sec) ⁴ | 2500 - 5600 | | | | | | | |
| RWS ⁵ | 92 | 89 | 86 | 84 | 84 | 81 | 76 | 68 |
| RBS ⁵ | 110 | 120 | 133 | 134 | 118 | 114 | 106 | 95 |
| CO ₂ Emissions (tCO ₂ e/t) ⁶ | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 |

NOTES:

1. For gassed products this is the nominal open cup density. For design purposes refer to the Dyno Nobel Gassing Tables for average in-hole densities.
2. Average in-hole density may be higher under real loading conditions.
3. All Dyno Nobel energy and gas values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.
4. The values stated are typical of those recorded for the product in various hole diameters, densities and ground. The Velocity of Detonation (VOD) is dependent upon many factors, including: the initiation system used, the product density, blasthole diameter and ground confinement.
5. For calculation of Relative Weight Strength (RWS) and Relative Bulk Strength (RBS); ANFO – density 0.82g/cm³ and an energy of 3.7MJ/kg was used.
6. CO₂ Emissions calculated as tonne of CO₂ equivalents per tonne of explosive. As per National Greenhouse Accounts; July 2012; Department of Climate Change and Energy Efficiency

Hazardous Shipping Description

Explosive, Blasting, Type E 1.1D UN 0241



TITAN[®] 5000

Matrix Blend Series

Application Recommendations

Priming: TITAN 5000 matrix blends are booster sensitive and should be primed with a minimum 400g cast booster. Additional 400g boosters should be used where there is risk of column disruption. Contact your Dyno Nobel representative if you intend using detonating cord down lines.

Elevated Temperature and Reactive Ground Conditions: In reactive (pyritic) ground conditions and/or in ground with temperatures greater than 55°C, please consult your local Dyno Nobel representative to undertake testing to determine the appropriate emulsion blend and maximum sleep time available at the maximum ground temperature. The appropriate blend and maximum sleep time are established by conducting reactive ground testing according to the *AEISG Code of Practice: Elevated Temperature and Reactive Ground*.

Non Reactive Conditions: Under ideal conditions in non reactive ground with temperatures less than 55°C, TITAN 5000 matrix blends may be slept for a maximum of 21 days. Sleep time is influenced by factors including the ground conditions and initiating system.

Sensitisation: TITAN 5000 matrix blends containing 60% or more emulsion must be sensitised as the product is delivered to the blasthole. Incorrectly sensitised gassed blends may lead to poor explosive performance and the formation of excessive post blast fume (NOx).

TITAN 5050 blends: Although not necessary in hole depths less than 11m, it is recommended that all 50% blends are sensitised. Over-sensitisation may lead to product collapse and formation of NOx. For depths exceeding 60m contact your Dyno Nobel representative.

Safe Handling, Transportation and Storage

First Aid – You can find detailed first aid information on the relevant Dyno Nobel Safety Data Sheet. Refer to www.dynonobel.com for more information if required.

Safety - All explosives are classified as dangerous goods and may cause personal injury and damage to property if used incorrectly.

Shelf Life: All TITAN matrices have a shelf life of three (3) months when transported and stored under ideal conditions.

Transportation and Storage - All explosives must be handled, transported and stored in accordance with all relevant regulations. Stock should be rotated such that older product is used first.

Technical
Information



Product Selection Guide

TITAN 5000 matrix blends may be slept for a maximum of 21 days in non-reactive ground. Where there is a risk of post blast fume the sleep times should be reduced based on a blast specific risk assessment. For assistance please contact your Dyno Nobel representative.

| Emulsion Content % w/w | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | |
|------------------------|------------------------------|-----|----|----|-----|--------|------------------|-----|-----|-----|-----|--|
| Blasthole Condition | Dry ¹ Use | YES | | | | | | | | | | |
| | Delivery Method ² | A | A | A | A | A | A/P | A/P | A/P | A/P | A/P | |
| | Dewatered ³ Use | NO | | | YES | | | | | | | |
| | Delivery Method | | | | A | A | A/P | A/P | A/P | A/P | A/P | |
| | Wet ⁴ Use | NO | | | | | YES | | | | | |
| | Delivery Method | | | | | | P | P | P | P | P | |
| | Dynamic ⁵ Use | NO | | | | | | YES | | | | |
| | Delivery Method | | | | | | | P | P | P | P | |
| Sensitisation Required | | NO | | | | Note 6 | YES ⁷ | | | | | |

NOTES:

- Dry hole is defined as a blasthole containing no water including no wet walls.
- A – Auger, P – Pumped.
- A dewatered hole is defined as not recharging with water.
- A wet hole is defined as a blasthole containing static water or has a recharge rate of <1m in 30 minutes.
- Dynamic water is defined as a recharge rate of >1m in 30 minutes. If the level of dynamic water is such that product damage is suspected or observed, the suggested recommended sleep time should be reduced.
- This product has reduced sensitivity and sensitisation is recommended for all holes. Please consult your Dyno Nobel representative to check which delivery options are available at your location.
- The TITAN Matrix Blend Gassing Table should be used to determine the appropriate open cup density for the hole depth.

Product Disclaimer The explosive products discussed in this document should only be handled by persons with the appropriate technical skills, training and licences. While Dyno Nobel has made every effort to ensure the information in this document is correct, every user is responsible for understanding the safe and correct use of the products. If you need specific technical advice or have any questions, you should contact your Dyno Nobel representative. This information is provided without any warranty, express or implied, regarding its correctness or accuracy and, to the maximum extent permitted by law, Dyno Nobel expressly disclaims any and all liability arising from the use of this document or the information contained herein. It is solely the responsibility of the user to make enquiries, obtain advice and determine the safe conditions for use of the products referred to herein and the user assumes liability for any loss, damage, expense or cost resulting from such use.
 © DYNO, GROUNDBREAKING PERFORMANCE, TITAN, DETAPRILL and the Person and Pipe Device are registered trademarks of the Dyno Nobel / Incitec Pivot Group.
 © Dyno Nobel Asia Pacific Pty Limited 2019 Reproduction without permission strictly prohibited.

TITAN[®] Matrix Blend Gassing Table

TITAN 5050G

Technical
Information



USE OF TABLE

- The left hand column in this table (Depth) indicates the height of the product column under **dry or dewatered hole conditions**.
- This table applies for TITAN 5000 Matrix blends with an emulsion content of **50% w/w ONLY**, i.e. **T5050G and T5050**.
- Emulsion explosives behave as liquids when subjected to the gravitational stress in a vertical blasthole, and a pressure gradient in the explosive will be established. The higher the explosive column in the blasthole, the higher the internal pressure at the bottom of the column, and the larger the quantity of gassing chemicals that need to be added to provide sensitisation.
- The open cup density is a measure of the level of sensitisation of the product. It is necessary to choose an open cup density to ensure that the density of the explosive at the bottom of the blasthole is less than the critical density. Inappropriate sensitisation may lead to poor detonation, fragmentation and generation of excessive post blast fume.
Blacked out areas indicate where critical density is reached or exceeded.
- For example, **To determine the required open cup density for an explosive** column of 40m, find 40m in the Depth column. Moving to the right, read off the density in the unshaded column under the required open cup density (a **TOE** density of 1.40g/cm³ in the 1.10g/cm³ open cup density column). This indicates that sufficient gassing chemicals should be added to the gassed explosive blend during delivery so that an open cup density of 1.10g/cm³ is achieved.
This level of gassing chemicals will ensure that the density at the bottom of the column will be below the critical density, and the column will detonate at full order upon initiation.
- For example, **To determine the approximate average in-hole density** in a column of 40m find 40m in the Depth column. Moving to the right, read off the density in the shaded column (an **AVG. IN-HOLE** density of 1.31g/cm³ in the 1.10 g/cm³ open cup density column).
For depths that are not listed, Dyno Nobel recommends rounding up to the next highest depth, e.g. a 25 m deep hole should be rounded to 26 m and corresponding densities applied.
- Blast design should be based on the average in-hole density, whilst blasthole loading requires the MPU operator to achieve the associated open cup density.
- The gassing reaction takes 30-40 minutes to achieve the desired open cup density at 20°C. It is necessary to allow at least this time to elapse following completion of loading and before stemming the charged blasthole. A longer period should be allowed at lower temperatures.
- The density values shown were calculated using a laboratory mathematical model that was validated using a specially designed fit-for-purpose pressure-volume apparatus.
- The low density explosive grade ammonium nitrate used in the model was assigned a bulk density of 0.77 g/cm³ and a particle density of 1.58 g/cm³.

| Depth (m) | TITAN 5050G Density g/cc | | | | | | Ungassed | |
|-----------|--------------------------|------|--------------|------|--------------|------|--------------|------|
| | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe |
| Open Cup | 1.10 | 1.10 | 1.15 | 1.15 | 1.20 | 1.20 | 1.31 | 1.31 |
| 1 | 1.12 | 1.13 | 1.17 | 1.18 | 1.21 | 1.23 | 1.33 | 1.34 |
| 2 | 1.13 | 1.16 | 1.18 | 1.21 | 1.23 | 1.25 | 1.33 | 1.35 |
| 3 | 1.15 | 1.19 | 1.19 | 1.23 | 1.24 | 1.27 | 1.34 | 1.36 |
| 4 | 1.16 | 1.21 | 1.20 | 1.25 | 1.25 | 1.28 | 1.35 | 1.37 |
| 5 | 1.17 | 1.23 | 1.21 | 1.26 | 1.25 | 1.30 | 1.35 | 1.37 |
| 6 | 1.18 | 1.25 | 1.22 | 1.28 | 1.26 | 1.31 | 1.36 | 1.38 |
| 7 | 1.19 | 1.26 | 1.23 | 1.29 | 1.27 | 1.32 | 1.36 | 1.39 |
| 8 | 1.20 | 1.27 | 1.24 | 1.30 | 1.28 | 1.33 | 1.36 | 1.39 |
| 9 | 1.21 | 1.28 | 1.25 | 1.31 | 1.28 | 1.34 | 1.37 | 1.40 |
| 10 | 1.22 | 1.29 | 1.25 | 1.32 | 1.29 | 1.34 | 1.37 | 1.40 |
| 11 | 1.22 | 1.30 | 1.26 | 1.33 | 1.29 | 1.35 | 1.37 | 1.40 |
| 12 | 1.23 | 1.31 | 1.26 | 1.33 | 1.30 | 1.36 | | |
| 13 | 1.24 | 1.32 | 1.27 | 1.34 | 1.30 | 1.36 | | |
| 14 | 1.24 | 1.32 | 1.27 | 1.35 | 1.31 | 1.37 | | |
| 15 | 1.25 | 1.33 | 1.28 | 1.35 | 1.31 | 1.37 | | |
| 16 | 1.25 | 1.34 | 1.28 | 1.36 | 1.31 | 1.37 | | |
| 17 | 1.26 | 1.34 | 1.29 | 1.36 | 1.32 | 1.38 | | |
| 18 | 1.26 | 1.35 | 1.29 | 1.36 | 1.32 | 1.38 | | |
| 19 | 1.27 | 1.35 | 1.30 | 1.37 | 1.32 | 1.38 | | |
| 20 | 1.27 | 1.36 | 1.30 | 1.37 | 1.33 | 1.39 | | |
| 22 | 1.28 | 1.36 | 1.30 | 1.38 | 1.33 | 1.39 | | |
| 24 | 1.28 | 1.37 | 1.31 | 1.38 | 1.33 | 1.40 | | |
| 26 | 1.28 | 1.37 | 1.31 | 1.39 | 1.34 | 1.40 | | |
| 28 | 1.29 | 1.38 | 1.31 | 1.39 | 1.34 | 1.40 | | |
| 30 | 1.29 | 1.38 | 1.32 | 1.40 | | | | |
| 32 | 1.29 | 1.39 | 1.32 | 1.40 | | | | |
| 34 | 1.30 | 1.39 | 1.32 | 1.40 | | | | |
| 36 | 1.30 | 1.39 | 1.33 | 1.40 | | | | |
| 38 | 1.30 | 1.40 | | | | | | |
| 40 | 1.31 | 1.40 | | | | | | |
| 45 | 1.31 | 1.40 | | | | | | |
| 50 | 1.31 | 1.40 | | | | | | |
| 55 | 1.32 | 1.40 | | | | | | |
| 60 | 1.32 | 1.40 | | | | | | |

TITAN[®] Matrix Blend Gassing Table

TITAN 5060G

Technical
Information



USE OF TABLE

- The left hand column in this table (Depth) indicates the height of the product column under **dry hole conditions**. In **wet hole** conditions, the value selected from the left hand column must be the sum of the product column and the height of the water column in the hole. If the length of the product and water column exceeds the depth of the hole then the value selected from the left hand column must be the hole depth.
- This table applies for TITAN 5000 Matrix blends with an emulsion content of **60% w/w ONLY**, i.e. **T5060G**.
- Emulsion explosives behave as liquids when subjected to the gravitational stress in a vertical blasthole, and a pressure gradient in the explosive will be established. The higher the explosive column in the blasthole, the higher the internal pressure at the bottom of the column, and the larger the quantity of gassing chemicals that need to be added to provide sensitisation.
- The open cup density is a measure of the level of sensitisation of the product. It is necessary to choose an open cup density to ensure that the density of the explosive at the bottom of the blasthole is less than the critical density. Inappropriate sensitisation may lead to poor detonation, fragmentation and generation of excessive post blast fume.
Blacked out areas indicate where critical density is reached or exceeded.
- For example, **To determine the required open cup density for an explosive** column of 40m, find 40m in the Depth column. Moving to the right, read off the density in the unshaded column under the required open cup density (a **TOE** density of 1.38g/cm³ in the 1.10 g/cm³ open cup density column). This indicates that sufficient gassing chemicals should be added to the gassed explosive blend during delivery so that an open cup density of 1.10g/cm³ is achieved.
This level of gassing chemicals will ensure that the density at the bottom of the column will be below the critical density, and the column will detonate at full order upon initiation.
- For example, **To determine the approximate average in-hole density** in a column of 40m find 40m in the Depth column. Moving to the right, read off the density in the **shaded** column (an **AVG. IN-HOLE** density of 1.30g/cm³ in the 1.10 g/cm³ open cup density column).
For depths that are not listed, Dyno Nobel recommends rounding up to the next highest depth, e.g. a 25 m deep hole should be rounded to 26 m and corresponding densities applied.
- Blast design should be based on the average in-hole density, whilst blasthole loading requires the MPU operator to achieve the associated open cup density.
- The gassing reaction takes 30-40 minutes to achieve the desired open cup density at 20°C. It is necessary to allow at least this time to elapse following completion of loading and before stemming the charged blasthole. A longer period should be allowed at lower temperatures.
- The density values shown were calculated using a laboratory mathematical model that was validated using a specially designed fit-for-purpose pressure-volume apparatus.
- The low density explosive grade ammonium nitrate used in the model was assigned a bulk density of 0.77 g/cm³ and a particle density of 1.58 g/cm³.

| Depth (m) | TITAN 5060G Density g/cm ³ | | | | | | | | | | | | | |
|-----------------|---------------------------------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|
| | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe |
| Open Cup | 0.90 | 0.90 | 0.95 | 0.95 | 1.00 | 1.00 | 1.05 | 1.05 | 1.10 | 1.10 | 1.15 | 1.15 | 1.20 | 1.20 |
| 1 | 0.92 | 0.94 | 0.97 | 0.99 | 1.02 | 1.04 | 1.07 | 1.09 | 1.12 | 1.13 | 1.16 | 1.18 | 1.21 | 1.22 |
| 2 | 0.94 | 0.98 | 0.99 | 1.03 | 1.04 | 1.07 | 1.08 | 1.12 | 1.13 | 1.16 | 1.18 | 1.20 | 1.22 | 1.25 |
| 3 | 0.96 | 1.02 | 1.01 | 1.06 | 1.05 | 1.10 | 1.10 | 1.14 | 1.14 | 1.18 | 1.19 | 1.22 | 1.23 | 1.26 |
| 4 | 0.98 | 1.05 | 1.02 | 1.09 | 1.07 | 1.13 | 1.11 | 1.17 | 1.16 | 1.20 | 1.20 | 1.24 | 1.24 | 1.28 |
| 5 | 0.99 | 1.07 | 1.04 | 1.11 | 1.08 | 1.15 | 1.12 | 1.19 | 1.17 | 1.22 | 1.21 | 1.26 | 1.25 | 1.29 |
| 6 | 1.01 | 1.10 | 1.05 | 1.13 | 1.09 | 1.17 | 1.14 | 1.20 | 1.18 | 1.24 | 1.22 | 1.27 | 1.26 | 1.30 |
| 7 | 1.02 | 1.12 | 1.06 | 1.15 | 1.11 | 1.19 | 1.15 | 1.22 | 1.19 | 1.25 | 1.23 | 1.28 | 1.26 | 1.31 |
| 8 | 1.04 | 1.14 | 1.08 | 1.17 | 1.12 | 1.20 | 1.16 | 1.23 | 1.19 | 1.26 | 1.23 | 1.29 | 1.27 | 1.32 |
| 9 | 1.05 | 1.16 | 1.09 | 1.19 | 1.13 | 1.22 | 1.17 | 1.25 | 1.20 | 1.27 | 1.24 | 1.30 | 1.28 | 1.33 |
| 10 | 1.06 | 1.17 | 1.10 | 1.20 | 1.14 | 1.23 | 1.17 | 1.26 | 1.21 | 1.28 | 1.25 | 1.31 | 1.28 | 1.33 |
| 11 | 1.07 | 1.19 | 1.11 | 1.21 | 1.14 | 1.24 | 1.18 | 1.27 | 1.22 | 1.29 | 1.25 | 1.32 | 1.29 | 1.34 |
| 12 | 1.08 | 1.20 | 1.12 | 1.23 | 1.15 | 1.25 | 1.19 | 1.28 | 1.22 | 1.30 | 1.26 | 1.32 | 1.29 | 1.34 |
| 13 | 1.09 | 1.21 | 1.13 | 1.24 | 1.16 | 1.26 | 1.20 | 1.28 | 1.23 | 1.31 | 1.26 | 1.33 | 1.29 | 1.35 |
| 14 | 1.10 | 1.22 | 1.13 | 1.25 | 1.17 | 1.27 | 1.20 | 1.29 | 1.23 | 1.31 | 1.27 | 1.33 | 1.30 | 1.35 |
| 15 | 1.11 | 1.23 | 1.14 | 1.25 | 1.17 | 1.28 | 1.21 | 1.30 | 1.24 | 1.32 | 1.27 | 1.34 | 1.30 | 1.36 |
| 16 | 1.11 | 1.24 | 1.15 | 1.26 | 1.18 | 1.28 | 1.21 | 1.30 | 1.24 | 1.32 | 1.28 | 1.34 | 1.31 | 1.36 |
| 17 | 1.12 | 1.25 | 1.15 | 1.27 | 1.19 | 1.29 | 1.22 | 1.31 | 1.25 | 1.33 | 1.28 | 1.35 | 1.31 | 1.36 |
| 18 | 1.13 | 1.26 | 1.16 | 1.28 | 1.19 | 1.30 | 1.22 | 1.31 | 1.25 | 1.33 | 1.28 | 1.35 | 1.31 | 1.37 |
| 19 | 1.14 | 1.26 | 1.17 | 1.28 | 1.20 | 1.30 | 1.23 | 1.32 | 1.26 | 1.34 | 1.29 | 1.35 | 1.31 | 1.37 |
| 20 | 1.14 | 1.27 | 1.17 | 1.29 | 1.20 | 1.31 | 1.23 | 1.32 | 1.26 | 1.34 | 1.29 | 1.36 | 1.32 | 1.37 |
| 22 | 1.15 | 1.28 | 1.18 | 1.30 | 1.21 | 1.32 | 1.24 | 1.33 | 1.27 | 1.35 | 1.29 | 1.36 | 1.32 | 1.38 |
| 24 | 1.15 | 1.29 | 1.18 | 1.31 | 1.21 | 1.32 | 1.24 | 1.34 | 1.27 | 1.35 | 1.30 | 1.37 | 1.32 | 1.38 |
| 26 | 1.16 | 1.30 | 1.19 | 1.32 | 1.22 | 1.33 | 1.25 | 1.35 | 1.27 | 1.36 | 1.30 | 1.37 | 1.32 | 1.38 |
| 28 | 1.17 | 1.31 | 1.20 | 1.32 | 1.22 | 1.34 | 1.25 | 1.35 | 1.28 | 1.36 | 1.30 | 1.38 | 1.33 | 1.39 |
| 30 | 1.17 | 1.32 | 1.20 | 1.33 | 1.23 | 1.34 | 1.25 | 1.36 | 1.28 | 1.37 | 1.31 | 1.38 | 1.33 | 1.39 |
| 32 | 1.18 | 1.32 | 1.21 | 1.34 | 1.23 | 1.35 | 1.26 | 1.36 | 1.28 | 1.37 | 1.31 | 1.38 | 1.33 | 1.39 |
| 34 | 1.18 | 1.33 | 1.21 | 1.34 | 1.24 | 1.35 | 1.26 | 1.36 | 1.29 | 1.37 | 1.31 | 1.39 | | |
| 36 | 1.19 | 1.34 | 1.22 | 1.35 | 1.24 | 1.36 | 1.27 | 1.37 | 1.29 | 1.38 | 1.31 | 1.39 | | |
| 38 | 1.19 | 1.34 | 1.22 | 1.35 | 1.24 | 1.36 | 1.27 | 1.37 | 1.29 | 1.38 | 1.32 | 1.39 | | |
| 40 | 1.20 | 1.35 | 1.22 | 1.36 | 1.25 | 1.36 | 1.27 | 1.37 | 1.30 | 1.38 | 1.32 | 1.39 | | |
| 45 | 1.20 | 1.35 | 1.23 | 1.36 | 1.25 | 1.37 | 1.28 | 1.38 | 1.30 | 1.38 | 1.32 | 1.39 | | |
| 50 | 1.21 | 1.35 | 1.23 | 1.36 | 1.26 | 1.37 | 1.28 | 1.38 | 1.30 | 1.39 | 1.32 | 1.39 | | |
| 55 | 1.21 | 1.35 | 1.24 | 1.36 | 1.26 | 1.37 | 1.28 | 1.38 | 1.30 | 1.39 | 1.33 | 1.39 | | |
| 60 | 1.22 | 1.35 | 1.24 | 1.36 | 1.26 | 1.37 | 1.28 | 1.38 | 1.31 | 1.39 | 1.33 | 1.39 | | |

TITAN[®] Matrix Blend Gassing Table

TITAN 5070G

Technical
Information



USE OF TABLE

1. The left hand column in this table (Depth) indicates the height of the product column under **dry hole conditions**. In **wet hole** conditions, the value selected from the left hand column must be the sum of the product column plus the height of the water column in the hole. If the length of the product and water column exceeds the depth of the hole then the value selected from the left hand column must be the hole depth.

2. This table applies for TITAN 5000 Matrix blends with an emulsion content of **70% w/w ONLY**, i.e. **T5070G**.

3. Emulsion explosives behave as liquids when subjected to the gravitational stress in a vertical blasthole, and a pressure gradient in the explosive will be established. The higher the explosive column in the blasthole, the higher the internal pressure at the bottom of the column, and the larger the quantity of gassing chemicals that need to be added to provide sensitisation.

4. The open cup density is a measure of the level of sensitisation of the product. It is necessary to choose an open cup density to ensure that the density of the explosive at the bottom of the blasthole is less than the critical density. Inappropriate sensitisation may lead to poor detonation, fragmentation and generation of excessive post blast fume.

Blacked out areas indicate where critical density is reached or exceeded.

5. For example, **To determine the required open cup density for an explosive** column of 40m, find 40m in the Depth column. Moving to the right, read off the density in the unshaded column under the required open cup density (a **TOE** density of 1.37g/cm³ in the 1.10 g/cm³ open cup density column). This indicates that sufficient gassing chemicals should be added to the gassed explosive blend during delivery so that an open cup density of 1.10g/cm³ is achieved.

This level of gassing chemicals will ensure that the density at the bottom of the column will be below the critical density, and the column will detonate at full order upon initiation.

6. For example, **To determine the approximate average in-hole density** in a column of 40m find 40m in the Depth column. Moving to the right, read off the density in the shaded column (an **AVG. IN-HOLE** density of 1.28g/cm³ in the 1.10 g/cm³ open cup density column).

For depths that are not listed, Dyno Nobel recommends rounding up to the next highest depth, e.g. a 25 m deep hole should be rounded to 26 m and corresponding densities applied.

7. Blast design should be based on the average in-hole density, whilst blasthole loading requires the MPU operator to achieve the associated open cup density.

8. The gassing reaction takes 30-40 minutes to achieve the desired open cup density at 20°C. It is necessary to allow at least this time to elapse following completion of loading and before stemming the charged blasthole. A longer period should be allowed at lower temperatures.

9. The density values shown were calculated using a laboratory mathematical model that was validated using a specially designed fit-for-purpose pressure-volume apparatus.

10. The low density explosive grade ammonium nitrate used in the model was assigned a bulk density of 0.77 g/cm³ and a particle density of 1.58 g/cm³.

| Depth (m) | TITAN 5070G Density g/cm ³ | | | | | | | | | | | | | |
|-----------------|---------------------------------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|
| | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe | Avg. In-Hole | Toe |
| Open Cup | 0.90 | 0.90 | 0.95 | 0.95 | 1.00 | 1.00 | 1.05 | 1.05 | 1.10 | 1.10 | 1.15 | 1.15 | 1.20 | 1.20 |
| 1 | 0.92 | 0.94 | 0.97 | 0.99 | 1.02 | 1.04 | 1.07 | 1.08 | 1.12 | 1.13 | 1.16 | 1.18 | 1.21 | 1.22 |
| 2 | 0.94 | 0.98 | 0.99 | 1.02 | 1.04 | 1.07 | 1.08 | 1.11 | 1.13 | 1.16 | 1.18 | 1.20 | 1.22 | 1.24 |
| 3 | 0.96 | 1.01 | 1.00 | 1.05 | 1.05 | 1.10 | 1.10 | 1.14 | 1.14 | 1.18 | 1.19 | 1.22 | 1.23 | 1.26 |
| 4 | 0.97 | 1.04 | 1.02 | 1.08 | 1.07 | 1.12 | 1.11 | 1.16 | 1.15 | 1.20 | 1.20 | 1.23 | 1.24 | 1.27 |
| 5 | 0.99 | 1.07 | 1.03 | 1.11 | 1.08 | 1.14 | 1.12 | 1.18 | 1.16 | 1.21 | 1.20 | 1.25 | 1.25 | 1.28 |
| 6 | 1.00 | 1.09 | 1.05 | 1.13 | 1.09 | 1.16 | 1.13 | 1.20 | 1.17 | 1.23 | 1.21 | 1.26 | 1.25 | 1.29 |
| 7 | 1.02 | 1.11 | 1.06 | 1.15 | 1.10 | 1.18 | 1.14 | 1.21 | 1.18 | 1.24 | 1.22 | 1.27 | 1.26 | 1.30 |
| 8 | 1.03 | 1.13 | 1.07 | 1.16 | 1.11 | 1.19 | 1.15 | 1.22 | 1.19 | 1.25 | 1.23 | 1.28 | 1.26 | 1.31 |
| 9 | 1.04 | 1.15 | 1.08 | 1.18 | 1.12 | 1.21 | 1.16 | 1.24 | 1.20 | 1.26 | 1.23 | 1.29 | 1.27 | 1.32 |
| 10 | 1.05 | 1.16 | 1.09 | 1.19 | 1.13 | 1.22 | 1.17 | 1.25 | 1.20 | 1.27 | 1.24 | 1.30 | 1.27 | 1.32 |
| 11 | 1.06 | 1.17 | 1.10 | 1.20 | 1.14 | 1.23 | 1.17 | 1.25 | 1.21 | 1.28 | 1.24 | 1.30 | 1.28 | 1.33 |
| 12 | 1.07 | 1.19 | 1.11 | 1.21 | 1.15 | 1.24 | 1.18 | 1.26 | 1.22 | 1.29 | 1.25 | 1.31 | 1.28 | 1.33 |
| 13 | 1.08 | 1.20 | 1.12 | 1.22 | 1.15 | 1.25 | 1.19 | 1.27 | 1.22 | 1.29 | 1.25 | 1.31 | 1.29 | 1.34 |
| 14 | 1.09 | 1.21 | 1.13 | 1.23 | 1.16 | 1.26 | 1.19 | 1.28 | 1.23 | 1.30 | 1.26 | 1.32 | 1.29 | 1.34 |
| 15 | 1.10 | 1.22 | 1.13 | 1.24 | 1.17 | 1.26 | 1.20 | 1.28 | 1.23 | 1.30 | 1.26 | 1.32 | 1.29 | 1.34 |
| 16 | 1.11 | 1.23 | 1.14 | 1.25 | 1.17 | 1.27 | 1.20 | 1.29 | 1.24 | 1.31 | 1.27 | 1.33 | 1.30 | 1.35 |
| 17 | 1.11 | 1.24 | 1.15 | 1.26 | 1.18 | 1.28 | 1.21 | 1.30 | 1.24 | 1.31 | 1.27 | 1.33 | 1.30 | 1.35 |
| 18 | 1.12 | 1.24 | 1.15 | 1.26 | 1.18 | 1.28 | 1.21 | 1.30 | 1.24 | 1.32 | 1.27 | 1.34 | 1.30 | 1.35 |
| 19 | 1.13 | 1.25 | 1.16 | 1.27 | 1.19 | 1.29 | 1.22 | 1.31 | 1.25 | 1.32 | 1.28 | 1.34 | 1.30 | 1.35 |
| 20 | 1.13 | 1.26 | 1.16 | 1.27 | 1.19 | 1.29 | 1.22 | 1.31 | 1.25 | 1.33 | 1.28 | 1.34 | 1.31 | 1.36 |
| 22 | 1.14 | 1.27 | 1.17 | 1.29 | 1.20 | 1.30 | 1.23 | 1.32 | 1.26 | 1.33 | 1.28 | 1.35 | 1.31 | 1.36 |
| 24 | 1.14 | 1.28 | 1.17 | 1.29 | 1.20 | 1.31 | 1.23 | 1.32 | 1.26 | 1.34 | 1.29 | 1.35 | 1.31 | 1.37 |
| 26 | 1.15 | 1.29 | 1.18 | 1.30 | 1.21 | 1.32 | 1.24 | 1.33 | 1.26 | 1.34 | 1.29 | 1.36 | 1.31 | 1.37 |
| 28 | 1.16 | 1.29 | 1.18 | 1.31 | 1.21 | 1.32 | 1.24 | 1.34 | 1.27 | 1.35 | 1.29 | 1.36 | 1.32 | 1.37 |
| 30 | 1.16 | 1.30 | 1.19 | 1.32 | 1.22 | 1.33 | 1.24 | 1.34 | 1.27 | 1.35 | 1.29 | 1.36 | 1.32 | 1.37 |
| 32 | 1.17 | 1.31 | 1.19 | 1.32 | 1.22 | 1.33 | 1.25 | 1.34 | 1.27 | 1.36 | 1.30 | 1.37 | | |
| 34 | 1.17 | 1.31 | 1.20 | 1.33 | 1.23 | 1.34 | 1.25 | 1.35 | 1.28 | 1.36 | 1.30 | 1.37 | | |
| 36 | 1.18 | 1.32 | 1.20 | 1.33 | 1.23 | 1.34 | 1.25 | 1.35 | 1.28 | 1.36 | 1.30 | 1.37 | | |
| 38 | 1.18 | 1.32 | 1.21 | 1.33 | 1.23 | 1.34 | 1.26 | 1.35 | 1.28 | 1.36 | 1.30 | 1.37 | | |
| 40 | 1.19 | 1.33 | 1.21 | 1.34 | 1.24 | 1.35 | 1.26 | 1.36 | 1.28 | 1.37 | | | | |
| 45 | 1.19 | 1.33 | 1.22 | 1.34 | 1.24 | 1.35 | 1.26 | 1.36 | 1.29 | 1.37 | | | | |
| 50 | 1.20 | 1.33 | 1.22 | 1.34 | 1.24 | 1.35 | 1.27 | 1.36 | 1.29 | 1.37 | | | | |
| 55 | 1.20 | 1.34 | 1.22 | 1.34 | 1.25 | 1.35 | 1.27 | 1.36 | 1.29 | 1.37 | | | | |
| 60 | 1.20 | 1.34 | 1.23 | 1.35 | 1.25 | 1.35 | 1.27 | 1.36 | 1.29 | 1.37 | | | | |