BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

PRODUCT DESCRIPTION

TITAN 9000 matrix is a high performance emulsion suitable for use in areas where there is risk of post blast fume generation. The specialised properties of TITAN 9000 have been formulated to provide optimal detonation characteristics and maximise product performance in challenging in-hole conditions. Titan 9000 is designed for use in small to medium diameter blast holes in open cut mining applications. The product is not suitable where reactive ground conditions exist.

- **TITAN 9000 Heavy ANFO Blends** contain TITAN 9000 emulsion with ≥50% ANFO composition[f], typically suitable for use in dry or dewatered blastholes. Titan 9000 Heavy ANFO blends are loaded using the auger of the Mobile Processing Unit (MPU).

- **TITAN 9000 Gassed Blends** are emulsion rich, water resistant mixtures of TITAN 9000 emulsion and ANFO. As the emulsion content of the blend increases, the water resistance properties of the product also increase. Gassed blends are pumped from the MPU through a loading hose to the bottom of wet blastholes. In some applications gassed product loaded via the auger may be available with delivery using specialised MPUs.

APPLICATION RECOMMENDATIONS

- **Priming Requirements -** TITAN 9000 matrix blends are booster sensitive and should be primed with a 400g cast booster in blastholes >102mm, or 150g cast boosters for blastholes <102mm. Additional boosters should be considered; where there's risk of column disruption; column length >10-15m; or in adverse blasting conditions. For further priming recommendations please contact your Dyno Nobel representative.
- **Ground Conditions -** TITAN 9000 is not suitable for use in reactive ground and/or ground temperatures >55°C. If reactive or elevated ground conditions exist, or are suspected, use of an inhibited product, such as TITAN 5000, is recommended in accordance with the AEISG Code of Practice: Elevated Temperature and Reactive Ground (AEISG CoP ETRG) and in consultation with your Dyno Nobel representative.
- **Sensitisation -** TITAN 9000 matrix blends containing 60% or more emulsion must be sensitised as the product is delivered in the blasthole. Incorrect sensitisation of gassed blends may lead to poor explosive performance and the formation of excessive post blast fume (NOx).

HAZARDOUS SHIPPING DESCRIPTION

Explosive, Blasting, Type E, 1.1D, UN0241

PROPERTIES

TITAN 9000 BLENDS	T9020	T9030	T9040	T9050G[f]	T9060G	T9070G	T9000G
Emulsion %	20	30	40	50	60	70	100
Cup Density [a, b] (g/cc) Avg	0.98	1.10	1.26	1.15	1.15	1.15	1.15
Energy [c] (MJ/kg)	3.5	3.4	3.3	3.2	3.1	3.0	2.7
Relative Weight Strength [d]	95	92	89	86	84	81	73
Relative Bulk Strength [d]	113	123	137	121	118	114	102
Minimum Diameter (mm)	102	102	127	102	89	76	76
Velocity of Detonation [e] (m/s)	3400 - 5600						

a For gassed products this is the nominal open cup density. For HANFO products this an average product density dependent on density of AN used.

b Average in-hole density may be higher under actual loading conditions, for design purposes refer to the product gassing tables.

c All Dyno Nobel energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel for its exclusive use. Other computer codes may give different values.

d For calculation of Relative Weight Strength (RWS) and Relative Bulk Strength (RBS); ANFO density of 0.82g/cm^3 and energy of 3.7 MJ/kg was used.

e The values stated are typical 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, product density, blasthole diameter and confinement, material strength, and ground conditions.

f T9050 has reduced sensitivity, and use of gassed product is recommended (may not be required for depths <11m). Please consult your Dyno Nobel representative to check delivery options available at your location.

Product Disclaimer: Please see final page

DYNO NOBEL

BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

PRODUCT SELECTION GUIDE

- The Product Blend Selection Table should be used to determine available product types to suit the blasthole conditions.
- TITAN 9000 matrix blends may be slept for a maximum of 21 days. In challenging blast hole conditions, such as high dynamic water exposure, reduction of sleep times should be considered.
- Where increased risk of post blast fume is evident, a risk assessment considering ground type & blasting conditions is recommended, and specific product & use conditions may apply.
- Alternate specialised fume product, Titan 9000xero®, may also be considered for softer ground and reduced weight and bulk strength blasting requirements. For assistance with product selection for high fume risk areas, contact your Dyno Nobel representative.

SAFE HANDLING, TRANSPORTATION, & STORAGE

- First Aid - You can find detailed first aid information on the relevant Dyno Nobel Safety Data Sheet. Refer to www.dynonobel.com.au 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.
- Transportation & Storage - All explosives must be handled, transported & stored in accordance with relevant regulations. TITAN 9000 emulsion matrix has a recommended shelf life of three (3) months when transported & stored under ideal conditions. If storage for longer duration is required, please consult your local Dyno Nobel representative to evaluate product quality. Stock should be rotated such that older product is used first.

PRODUCT BLEND SELECTION TABLE

BLAST HOLE CONDITIONS	T9020	T9030	T9040	T9050G [f]	T9060G	T9070G	T9000G
DRY [a]	Yes						
Delivery Method [b]	Auger				A/P		Pump
DEWATERED [c]	Not Suitable		Yes				
Delivery Method [b]			Auger		A/P		Pump
WET [d]	Not Suitable				Yes		
Delivery Method [b]					Pump		
DYNAMIC [e]	Not Suitable					Yes	
Delivery Method [b]						Pump	

a. Dry hole is defined as a blast hole containing no water including no wet walls.

b. A = Auger, P = Pump.

c. A dewatered hole is defined as not recharging with water.

d. A wet hole is defined as a blast hole containing static water or a recharge rate of <1m in 30mins.

e. Dynamic water is defined as a recharge rate of >1m in 30mins. If the level of dynamic water is such that product damage is suspected or observed, the recommended sleep time should be reduced.

f. T9050 has reduced sensitivity, and use of gassed product is recommended (may not be required for depths <11m). Please consult your Dyno Nobel representative to check delivery options available at your location.

Product sensitisation recommendations and gassing tables are shown on the following pages, with instructions for use of tables on the final page.

Product Disclaimer: Please see final page

DYNO NOBEL®

BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

TITAN 9050G BLEND DENSITY g/cm³

DEPTH product charge length [1] (m)	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density
OPEN CUP	1.10		1.15		1.20		1.25		1.30	
1	1.12	1.13	1.16	1.18	1.21	1.22	1.26	1.27	1.31	1.31
2	1.13	1.16	1.18	1.20	1.22	1.24	1.27	1.28	1.31	1.33
3	1.14	1.18	1.19	1.22	1.23	1.26	1.27	1.30	1.32	1.33
4	1.15	1.20	1.20	1.24	1.24	1.27	1.28	1.31	1.32	1.34
5	1.16	1.22	1.21	1.25	1.25	1.28	1.29	1.32	1.33	1.35
6	1.17	1.23	1.21	1.26	1.25	1.29	1.29	1.32	1.33	1.35
7	1.18	1.24	1.22	1.27	1.26	1.30	1.30	1.33	1.33	1.36
8	1.19	1.25	1.23	1.28	1.27	1.31	1.30	1.34	1.34	1.36
9	1.20	1.27	1.23	1.29	1.27	1.32	1.31	1.34	1.34	1.37
10	1.20	1.27	1.24	1.30	1.28	1.32	1.31	1.35	1.34	1.37
11	1.21	1.28	1.25	1.31	1.28	1.33	1.31	1.35	1.35	1.37
12	1.22	1.29	1.25	1.31	1.28	1.33	1.32	1.36	1.35	1.38
13	1.22	1.30	1.26	1.32	1.29	1.34	1.32	1.36	1.35	1.38
14	1.23	1.30	1.26	1.32	1.29	1.34	1.32	1.36	1.35	1.38
15	1.23	1.31	1.26	1.33	1.29	1.35	1.32	1.36		
16	1.24	1.31	1.27	1.33	1.30	1.35	1.33	1.37		
17	1.24	1.32	1.27	1.34	1.30	1.35	1.33	1.37		
18	1.25	1.32	1.28	1.34	1.30	1.36	1.33	1.37		
19	1.25	1.33	1.28	1.34	1.31	1.36	1.33	1.37		
20	1.25	1.33	1.28	1.35	1.31	1.36	1.34	1.38		
22	1.26	1.34	1.29	1.35	1.31	1.36	1.34	1.38		
24	1.27	1.34	1.29	1.36	1.32	1.37				
26	1.27	1.35	1.30	1.36	1.32	1.37				
28	1.28	1.35	1.30	1.36	1.33	1.38				
30	1.28	1.36	1.31	1.37	1.33	1.38				
32	1.29	1.36	1.31	1.37	1.33	1.38				
34	1.29	1.36	1.31	1.37						
36	1.30	1.37	1.32	1.37						
38	1.30	1.37	1.32	1.38						
40	1.30	1.37	1.32	1.38						
42	1.31	1.37	1.33	1.38						
44	1.31	1.37								
46	1.31	1.38								
48	1.31	1.38								
50	1.32	1.38								

Product Disclaimer: Please see final page

BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

TITAN 9060G BLEND DENSITY g/cm³

DEPTH product charge length [1] (m)	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density
OPEN CUP	0.90		0.95		1.00		1.05		1.10		1.15		1.20		1.25	
1	0.92	0.94	0.97	0.99	1.02	1.04	1.07	1.08	1.11	1.13	1.16	1.18	1.21	1.22	1.26	1.27
2	0.94	0.98	0.99	1.02	1.03	1.07	1.08	1.11	1.13	1.16	1.17	1.20	1.22	1.24	1.27	1.28
3	0.96	1.01	1.00	1.05	1.05	1.09	1.10	1.14	1.14	1.18	1.18	1.22	1.23	1.25	1.27	1.29
4	0.97	1.04	1.02	1.08	1.06	1.12	1.11	1.16	1.15	1.19	1.19	1.23	1.24	1.27	1.28	1.30
5	0.99	1.06	1.03	1.10	1.08	1.14	1.12	1.18	1.16	1.21	1.20	1.25	1.24	1.28	1.28	1.31
6	1.00	1.09	1.05	1.12	1.09	1.16	1.13	1.19	1.17	1.22	1.21	1.26	1.25	1.29	1.29	1.32
7	1.02	1.11	1.06	1.14	1.10	1.17	1.14	1.21	1.18	1.24	1.22	1.27	1.26	1.30	1.29	1.32
8	1.03	1.12	1.07	1.16	1.11	1.19	1.15	1.22	1.19	1.25	1.22	1.28	1.26	1.30	1.30	1.33
9	1.04	1.14	1.08	1.17	1.12	1.20	1.16	1.23	1.19	1.26	1.23	1.28	1.27	1.31	1.30	1.33
10	1.05	1.16	1.09	1.18	1.13	1.21	1.16	1.24	1.20	1.27	1.24	1.29	1.27	1.32	1.30	1.34
11	1.06	1.17	1.10	1.20	1.13	1.22	1.17	1.25	1.21	1.27	1.24	1.30	1.27	1.32	1.31	1.34
12	1.07	1.18	1.11	1.21	1.14	1.23	1.18	1.26	1.21	1.28	1.25	1.30	1.28	1.32	1.31	1.35
13	1.08	1.19	1.11	1.22	1.15	1.24	1.18	1.26	1.22	1.29	1.25	1.31	1.28	1.33	1.31	1.35
14	1.09	1.20	1.12	1.23	1.16	1.25	1.19	1.27	1.22	1.29	1.25	1.31	1.29	1.33	1.32	1.35
15	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	1.32	1.35
16	1.10	1.22	1.14	1.24	1.17	1.26	1.20	1.28	1.23	1.30	1.26	1.32	1.29	1.34	1.32	1.36
17	1.11	1.23	1.14	1.25	1.17	1.27	1.21	1.29	1.24	1.31	1.27	1.32	1.29	1.34	1.32	1.36
18	1.11	1.24	1.15	1.26	1.18	1.27	1.21	1.29	1.24	1.31	1.27	1.33	1.30	1.34	1.32	1.36
19	1.12	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	1.33	1.36
20	1.13	1.25	1.16	1.27	1.19	1.29	1.22	1.30	1.25	1.32	1.27	1.33	1.30	1.35	1.33	1.36
22	1.14	1.26	1.17	1.28	1.20	1.29	1.23	1.31	1.25	1.32	1.28	1.34	1.31	1.35		
24	1.15	1.27	1.18	1.29	1.21	1.30	1.23	1.32	1.26	1.33	1.29	1.34	1.31	1.36		
26	1.16	1.28	1.19	1.29	1.21	1.31	1.24	1.32	1.27	1.34	1.29	1.35	1.31	1.36		
28	1.17	1.29	1.19	1.30	1.22	1.31	1.25	1.33	1.27	1.34	1.29	1.35	1.32	1.36		
30	1.18	1.29	1.20	1.31	1.23	1.32	1.25	1.33	1.27	1.34	1.30	1.35	1.32	1.37		
32	1.18	1.30	1.21	1.31	1.23	1.32	1.26	1.34	1.28	1.35	1.30	1.36				
34	1.19	1.31	1.21	1.32	1.24	1.33	1.26	1.34	1.28	1.35	1.30	1.36				
36	1.20	1.31	1.22	1.32	1.24	1.33	1.27	1.34	1.29	1.35	1.31	1.36				
38	1.20	1.32	1.23	1.33	1.25	1.34	1.27	1.35	1.29	1.36	1.31	1.36				
40	1.21	1.32	1.23	1.33	1.25	1.34	1.27	1.35	1.29	1.36	1.31	1.37				
42	1.21	1.32	1.24	1.33	1.26	1.34	1.28	1.35	1.30	1.36						
44	1.22	1.33	1.24	1.34	1.26	1.34	1.28	1.35	1.30	1.36						
46	1.22	1.33	1.24	1.34	1.26	1.35	1.28	1.36	1.30	1.36						
48	1.23	1.33	1.25	1.34	1.27	1.35	1.29	1.36	1.30	1.37						
50	1.23	1.34	1.25	1.34	1.27	1.35	1.29	1.36								
55	1.24	1.34	1.26	1.35	1.28	1.36	1.30	1.36								
60	1.25	1.35	1.27	1.35	1.28	1.36										

Product Disclaimer: Please see final page

DYNO NOBEL

BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

TITAN 9070G BLEND DENSITY g/cm³

DEPTH product charge length [1] (m)	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density	AVERAGE in hole Density	TOE of hole Density
OPEN CUP	0.90		0.95		1.00		1.05		1.10		1.15		1.20		1.25	
1	0.92	0.94	0.97	0.99	1.02	1.03	1.07	1.08	1.11	1.13	1.16	1.17	1.21	1.22	1.26	1.27
2	0.94	0.97	0.99	1.02	1.03	1.07	1.08	1.11	1.13	1.15	1.17	1.19	1.22	1.24	1.26	1.28
3	0.96	1.01	1.00	1.05	1.05	1.09	1.09	1.13	1.14	1.17	1.18	1.21	1.23	1.25	1.27	1.29
4	0.97	1.03	1.02	1.07	1.06	1.11	1.11	1.15	1.15	1.19	1.19	1.23	1.23	1.26	1.28	1.30
5	0.99	1.06	1.03	1.10	1.07	1.13	1.12	1.17	1.16	1.21	1.20	1.24	1.24	1.27	1.28	1.31
6	1.00	1.08	1.04	1.12	1.08	1.15	1.13	1.19	1.17	1.22	1.21	1.25	1.25	1.28	1.29	1.31
7	1.01	1.10	1.05	1.13	1.09	1.17	1.14	1.20	1.17	1.23	1.21	1.26	1.25	1.29	1.29	1.32
8	1.02	1.12	1.06	1.15	1.10	1.18	1.14	1.21	1.18	1.24	1.22	1.27	1.26	1.30	1.29	1.32
9	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	1.30	1.30	1.33
10	1.04	1.15	1.08	1.18	1.12	1.20	1.16	1.23	1.20	1.26	1.23	1.28	1.27	1.31	1.30	1.33
11	1.05	1.16	1.09	1.19	1.13	1.21	1.17	1.24	1.20	1.26	1.24	1.29	1.27	1.31	1.30	1.33
12	1.06	1.17	1.10	1.20	1.14	1.22	1.17	1.25	1.21	1.27	1.24	1.29	1.27	1.32	1.30	1.34
13	1.07	1.18	1.11	1.21	1.14	1.23	1.18	1.26	1.21	1.28	1.24	1.30	1.28	1.32	1.31	1.34
14	1.08	1.19	1.12	1.22	1.15	1.24	1.18	1.26	1.22	1.28	1.25	1.30	1.28	1.32	1.31	1.34
15	1.09	1.20	1.12	1.23	1.16	1.25	1.19	1.27	1.22	1.29	1.25	1.31	1.28	1.33	1.31	1.34
16	1.09	1.21	1.13	1.23	1.16	1.25	1.19	1.27	1.22	1.29	1.26	1.31	1.28	1.33	1.31	1.35
17	1.10	1.22	1.13	1.24	1.17	1.26	1.20	1.28	1.23	1.30	1.26	1.31	1.29	1.33	1.32	1.35
18	1.11	1.23	1.14	1.25	1.17	1.26	1.20	1.28	1.23	1.30	1.26	1.32	1.29	1.33	1.32	1.35
19	1.11	1.23	1.15	1.25	1.18	1.27	1.21	1.29	1.24	1.30	1.26	1.32	1.29	1.34	1.32	1.35
20	1.12	1.24	1.15	1.26	1.18	1.27	1.21	1.29	1.24	1.31	1.27	1.32	1.29	1.34		
22	1.13	1.25	1.16	1.27	1.19	1.28	1.22	1.30	1.25	1.31	1.27	1.33	1.30	1.34		
24	1.14	1.26	1.17	1.27	1.20	1.29	1.23	1.30	1.25	1.32	1.28	1.33	1.30	1.35		
26	1.15	1.27	1.18	1.28	1.21	1.30	1.23	1.31	1.26	1.32	1.28	1.34	1.31	1.35		
28	1.16	1.27	1.19	1.29	1.21	1.30	1.24	1.32	1.26	1.33	1.29	1.34	1.31	1.35		
30	1.17	1.28	1.19	1.29	1.22	1.31	1.24	1.32	1.27	1.33	1.29	1.34				
32	1.17	1.29	1.20	1.30	1.22	1.31	1.25	1.32	1.27	1.33	1.29	1.35				
34	1.18	1.29	1.21	1.30	1.23	1.32	1.25	1.33	1.27	1.34	1.30	1.35				
36	1.19	1.30	1.21	1.31	1.23	1.32	1.26	1.33	1.28	1.34	1.30	1.35				
38	1.19	1.30	1.22	1.31	1.24	1.32	1.26	1.33	1.28	1.34	1.30	1.35				
40	1.20	1.31	1.22	1.32	1.24	1.33	1.26	1.34	1.28	1.35						
42	1.20	1.31	1.23	1.32	1.25	1.33	1.27	1.34	1.29	1.35						
44	1.21	1.31	1.23	1.32	1.25	1.33	1.27	1.34	1.29	1.35						
46	1.21	1.32	1.23	1.33	1.25	1.33	1.27	1.34	1.29	1.35						
48	1.22	1.32	1.24	1.33	1.26	1.34	1.28	1.34	1.29	1.35						
50	1.22	1.32	1.24	1.33	1.26	1.34	1.28	1.35								
55	1.23	1.33	1.25	1.34	1.27	1.34	1.29	1.35								
60	1.24	1.33	1.26	1.34	1.27	1.35										

Product Disclaimer: Please see final page

DYNO NOBEL

BULK EXPLOSIVES

TITAN® 9000

Heavy and Gassed Emulsion Blends

PRODUCT GASSING TABLES

USE OF TABLES

1. The left-hand column in all tables (DEPTH) indicates the height of the product column under dry or dewatered hole conditions. Where water is present, the height of water above the explosive column should be included to calculate depth.
2. Emulsion explosives behave as liquids when subjected to gravitational stress in a vertical blasthole, resulting in a pressure gradient in the explosive column to 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 needed to provide sensitisation.
3. The open cup density is a measure of the level of sensitisation of the product, whereby increasing the sensitisation of the product results in decreasing the density. It is necessary to choose a suitable open cup density to ensure the density of the explosive at the bottom of the blasthole (ie TOE) is less than the critical density. Inappropriate sensitisation may lead to poor detonation, fragmentation, and generation of excessive post blast fume. Shaded areas indicate where critical density is reached or exceeded.
4. To determine the required open cup density for an explosive column of 40m (for example), find 40m in the DEPTH column. Moving to the right, read the density options available directly under the corresponding open cup density row. For example, T9050G, at 40m indicates a maximum open cup density of 1.15g/cm^3 is suitable, therefore sufficient gassing chemicals should be added to the gassed explosive blend during delivery so that an open cup density of at least 1.15g/cm^3 or lower 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.
5. To determine the approximate average in-hole density in an explosive column of 40m (for example), find 40m in the DEPTH column. Moving to the right, read off the density in the shaded column, for example T9050G with an open cup density of 1.10g/cm^3 has an AVERAGE in hole density of 1.30g/cm^3.
6. For depths that are not listed, Dyno Nobel recommends rounding up to the next highest depth e.g. a 25m deep hole should be rounded to 26m and corresponding densities applied.
7. Blast design should be based on average in-hole density, whilst blasthole loading requires the MPU operator to achieve the associated open cup density applicable for the depth of the explosive charge length to be loaded.
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 are calculated using a laboratory mathematical model validated using a specially designed fit-for-purpose pressure-volume apparatus as well as in-field testing.
10. Titan emulsion blends with 50% emulsion, eg T9050G, may have reduced sensitivity in some mining conditions when loaded at depths of greater than 50m. It is recommended to contact your Dyno Nobel representative to determine product suitability for site loading conditions.
11. For the use of bulk products at depths and densities outside of the standard ranges provided, contact your Dyno Nobel representative.
12. The gassing density loading tables have been designed to calculate the ideal product loading recommendations to suit the majority of mining conditions. In some limited cases, successful loading and blasting outside these parameters may be suitable and will require consultation with a Dyno Nobel technical representative to determine specific product and loading requirements.

ADDITIONAL INFORMATION – Visit **dynonobel.com.au** for Brochures and Case Studies related to this product.

DYNO NOBEL