

ET2000 Plus

Guardrail Extruder Terminal

Product Manual



Release 04/15

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5.0 Installation

Only items provided by Ingal are to be used for the installation of the ET2000 Plus. The following written instructions are to be read in conjunction with Ingal's drawings. A generic Safe Work Method Statement is available upon request for installation operations.

5.1 Site Preparation.

The site should be prepared free of obstructing vegetation and other hazards that may interfere with the installation or operational performance of the system. This includes kerbs below the system and other hazards that may hinder the extruder head as it travels horizontally along the guardrail beams. Some sites may require minor grading if installed beyond the edge of the pavement shoulder.

Impacts occurring prior to the location of the 3rd post (point of need) may allow the vehicle to pass behind the barrier system. Therefore, the area immediately behind the terminal should be reasonably traversable and free from fixed object hazards. If a clear run-out is not possible, this area should be similar in character to adjacent unshielded roadside areas.

Since the terminal functions by extruding rail away from the traffic face, a risk assessment is recommended if pedestrians and/or cyclists will be accessing the area behind the terminal.

5.2 Set-Out

When the downstream guardrail system is installed parallel to the edge of the roadway without any offset, a 25:1 or flatter flare over the length of the ET2000 Plus may be used to locate the extruder head away from the roadway.

When the ET2000 Plus is installed at the end of guardrail following a curved alignment, the following should be adopted for the layout of the terminal. For both conditions, the ET2000 Plus must be straight over the length of the system. All offsets are measured to the face of the rail.

Outside of the Curve. The ET2000 Plus is to be installed with a maximum offset of 610mm from the curve.

Inside of the Curve. For a curve radius of 300m or less, the ET2000 Plus is to be installed with a maximum offset of 305mm from the curve. For a curve radius greater than 300m, the ET2000 Plus is to be installed with a maximum offset of 610mm from the curve.

When establishing the post locations of the terminal, take care to note the following;

- The first two posts from the end of the terminal have no offset blocking piece;
- The 200mm offset block used in the terminal is wider than conventional w-beam offset blocking pieces;
- The 1,905mm spacing for the SYT posts is different from the conventional w-beam barrier spacing of 2,000mm (2,500mm in Victoria).



Backfill material shall be placed and compacted to 95% maximum dry density in 150mm lifts. When the top of the drilled hole is not at the surface, the soil above the drilled hole should consist of native soil re-compacted to existing specifications. The post should be driven into the backfilled hole after compaction.

5.7 Installing the Angle Strut

- Place the angle iron strut (C1798G) between post 1 (HBA post) and post 2 (first SYT post).
- Attach the strut to post 1 (HBA post) with a $\frac{3}{4}$ " (20mm) diameter x $2\frac{1}{2}$ " (63mm) hex head high strength bolt (C1619) with a $\frac{3}{4}$ " (20mm) washer (C1617) and secure with a $\frac{3}{4}$ " (20mm) lock washer (C1624) and $\frac{3}{4}$ " (20mm) hex nut (C1618). Install so that the nut is on the inside of the ears.
- Attach the strut to post 2 (first SYT post) with 2 off $\frac{7}{16}$ " (11mm) diameter x $1\frac{1}{2}$ " (38mm) hex head bolts (C1629) with 2 off $\frac{7}{16}$ " (11mm) washers (C1628) and secure with 2 off $\frac{7}{16}$ " (11mm) lock washer (C1630) and $\frac{7}{16}$ " (11mm) hex nut (C1627). Install so that the nut is on the inside of the flange

There is no torque requirement for any of these bolts. They should be tightened to a snug position.



5.8 Installing Blocking Pieces and Rails

- Place the 190mm plastic King Block (C1797) on posts 3 through 8.
- Select 3 off 3.81m rail panels (C1355G) and 1 off 3.81m anchor rail (C1811G). The anchor rail should be orientated with the anchor bracket holes closest to the terminal end.
- At posts 3 through 8, bolt rail panels with the correct lap orientation with a $\frac{5}{8}$ " (16mm) diameter x 10" (255mm) long mushroom head post bolt. A $\frac{5}{8}$ " (16mm) diameter round washer (C1631) and a $\frac{5}{8}$ " (16mm) hex

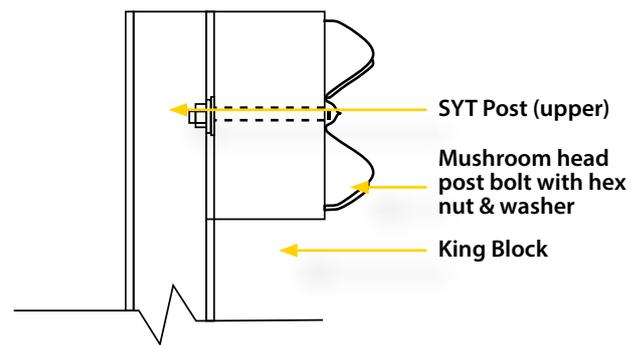
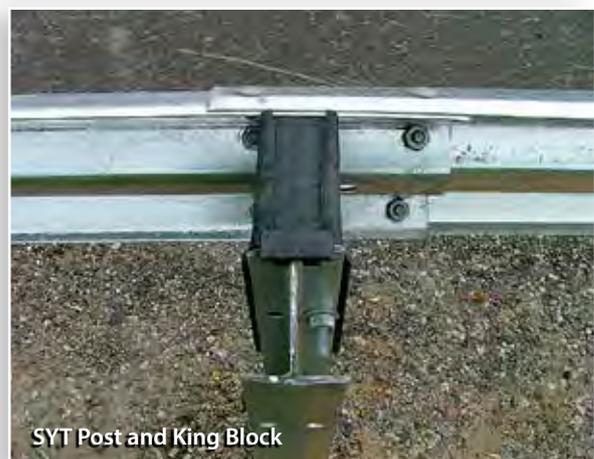


Figure 2: Attachment of King Block

nut (C1632) secures the rail and block to the post. The washer is located between the post and the nut. See Figure 2.

- At post 2, bolt the rail panel directly to the SYT post with a 16mm diameter x 32mm long mushroom head post bolt (C1550) and a 16mm washer (C1631) and hex nut (C1520). The washer is located between the post and the nut. No post bolt is used at post 1
- Splice the 3.81m rail panels together with eight 16mm diameter x 32mm long mushroom head splice bolts (C1550) and hex nuts (C1520).



ET2000 Plus Installation Checklist

Customer:

Project:

Barrier ID:

Terminal Type: TL2 TL3

Checked By:

Signed:

Date:

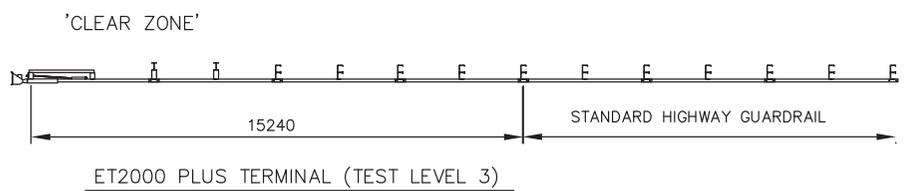
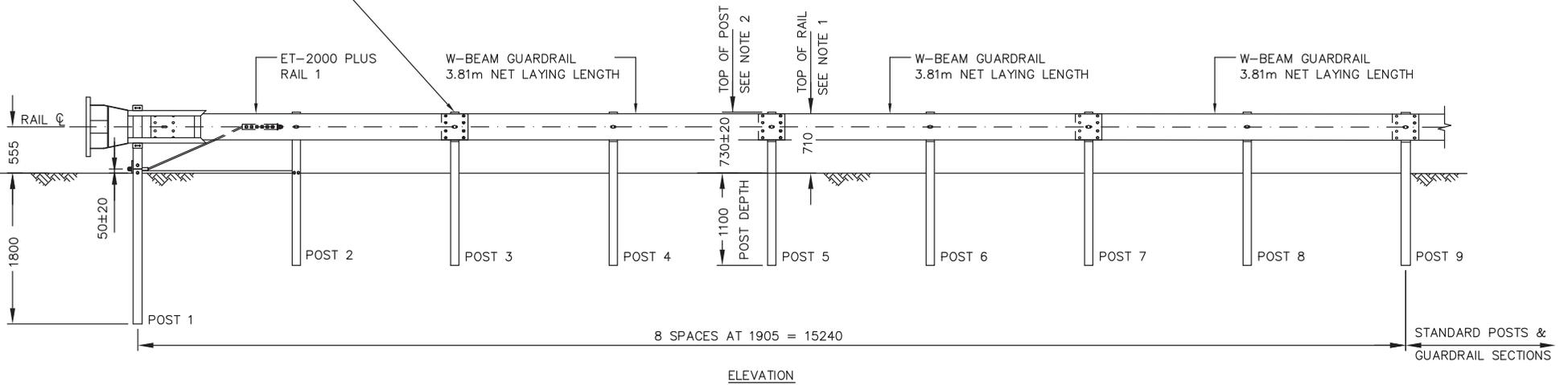
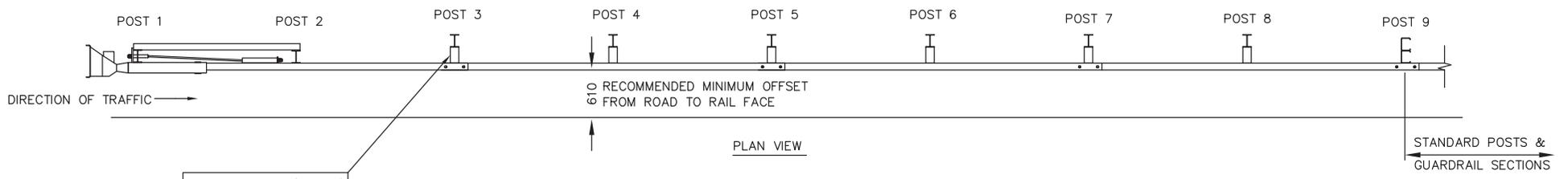
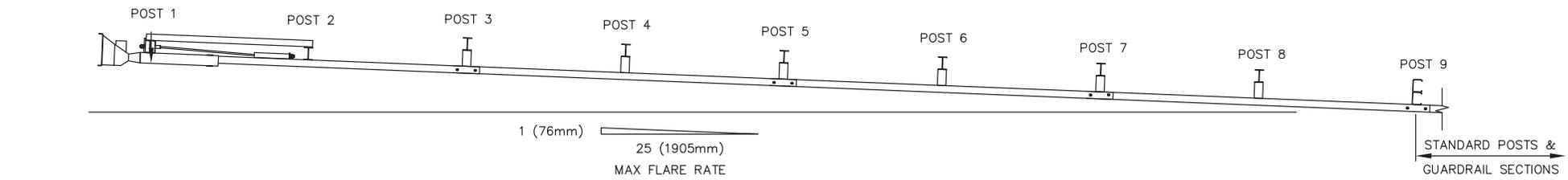
| | | |
|--|------------------------------|-----------------------------|
| Have the SYT posts been positioned every 1,905mm | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Does the bottom half of post 1 (HBA) protrude not more than 100mm above ground level | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are all bolts securing the top to the bottom of the HBA post tight | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are the SYT posts at the correct height of 730mm \pm 20mm above ground level | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the extruder head pushed to its maximum along the anchor rail | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the extruder head correctly orientated with the exit slot facing the rear of the guardrail system | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the area below the guardrails free from hazards so that the extruder head can travel freely upon impact | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the extruder head properly secured to post 1 through the attachment brackets | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Has delineation been attached to the extruder head | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have the rails been secured to posts 2 through 8 (posts 2 through 4 for the TL2 system) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have the rails been spliced with M16x32mm mushroom head bolts | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are all splice bolts and post bolts snug tight | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the fill material around each post suitably compacted | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the anchor cable secured between the anchor rail and post 1 | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the bearing plate correctly orientated | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the cable tensioned to 50Nm | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Has any minor damage been repaired using two coats of an organic zinc rich paint | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Does the terminal form a smooth line vertically and horizontally when viewed along the system | <input type="checkbox"/> Yes | <input type="checkbox"/> No |



Damaged ET2000 Plus Terminal

Table 2: Damage Assessment of ET2000

| Type of Defect | Description of the Defect | Action to be Taken |
|---------------------------------------|---|--|
| Galvanizing damage on posts. | The sum total of the damaged area does not exceed 45cm ² (0.5% of the total surface area) and no individual damaged area exceeds 40cm ² . The sum total of the damaged area exceeds 45cm ² (0.5% of the total surface area) or an individual damaged area exceeds 40cm ² . | An organic zinc rich epoxy paint is to be applied to the repair area in two coats. The post is to be replaced. |
| Galvanizing damage on rails. | The sum total of the damaged area does not exceed 200cm ² (0.5% of the total surface area) and no individual damaged area exceeds 40cm ² . The sum total of the damaged area exceeds 200cm ² (0.5% of the total surface area) or an individual damaged area exceeds 40cm ² . | An organic zinc rich epoxy paint is to be applied to the repair area in two coats. The rail is to be replaced. |
| Mechanical damage on blocking pieces | The blocking piece has chips or cracks. | The blocking piece is to be replaced. |
| Mechanical damage on SYT posts. | The post is bent. | The post is to be replaced. |
| Mechanical damage on extruder head | The extruder head has minor damage that will not prevent its travel along the rail. The extruder head is bent which will prevent its travel along the rail. The delineation tape is damaged. | The extruder head may be reused. The extruder head is to be replaced. The delineation tape is to be replaced. |
| Mechanical damage on rail. | The rail is dented, twisted or flattened. There are nicks in any part of the rail. The slots in the rail are distorted. | The rail is to be replaced. The rail is to be replaced. The rail is to be replaced. |
| Mechanical damage on bolts. | The body of the bolt is distorted. The thread of the bolt is damaged. | The bolt is to be replaced. The bolt is to be replaced. |
| Disturbance of material around posts. | The material around the post is loose or uncompacted. | Any disturbed pavement or material around a post shall be left dense, tight and smooth so that resistance to water penetration is similar to that of the adjacent surface. |



THE CLEAR ZONE IS DEFINED AS THE AREA BEHIND AN END TERMINAL THAT IS AVAILABLE FOR SAFE USE BY ERRANT VEHICLES.

THE SIZE OF THE CLEAR ZONE IS DEPENDANT UPON DESIGN SPEED, TRAFFIC VOLUME, AND ROADSIDE GEOMETRY (CROSS-SLOPE).

THE ROAD DESIGNER SHALL SPECIFY CLEAR ZONE DIMENSIONS TO COMPLY WITH THE REQUIREMENTS OF THE RELEVANT STATE ROAD AUTHORITY.

NOTES:

1. RAIL HEIGHT DIMENSIONS ARE TYPICAL. IF VARIANCE FROM ROAD CONTROLLING AUTHORITY, ROAD AUTHORITY RAIL HEIGHT SHOULD BE USED.
2. IF RAIL HEIGHT IS TO BE MODIFIED AS PER NOTE 1, NEW POST HEIGHT SHOULD BE RAIL HEIGHT PLUS 20mm.

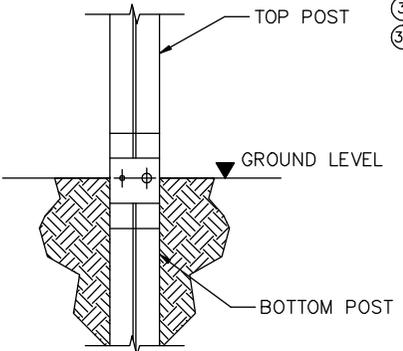
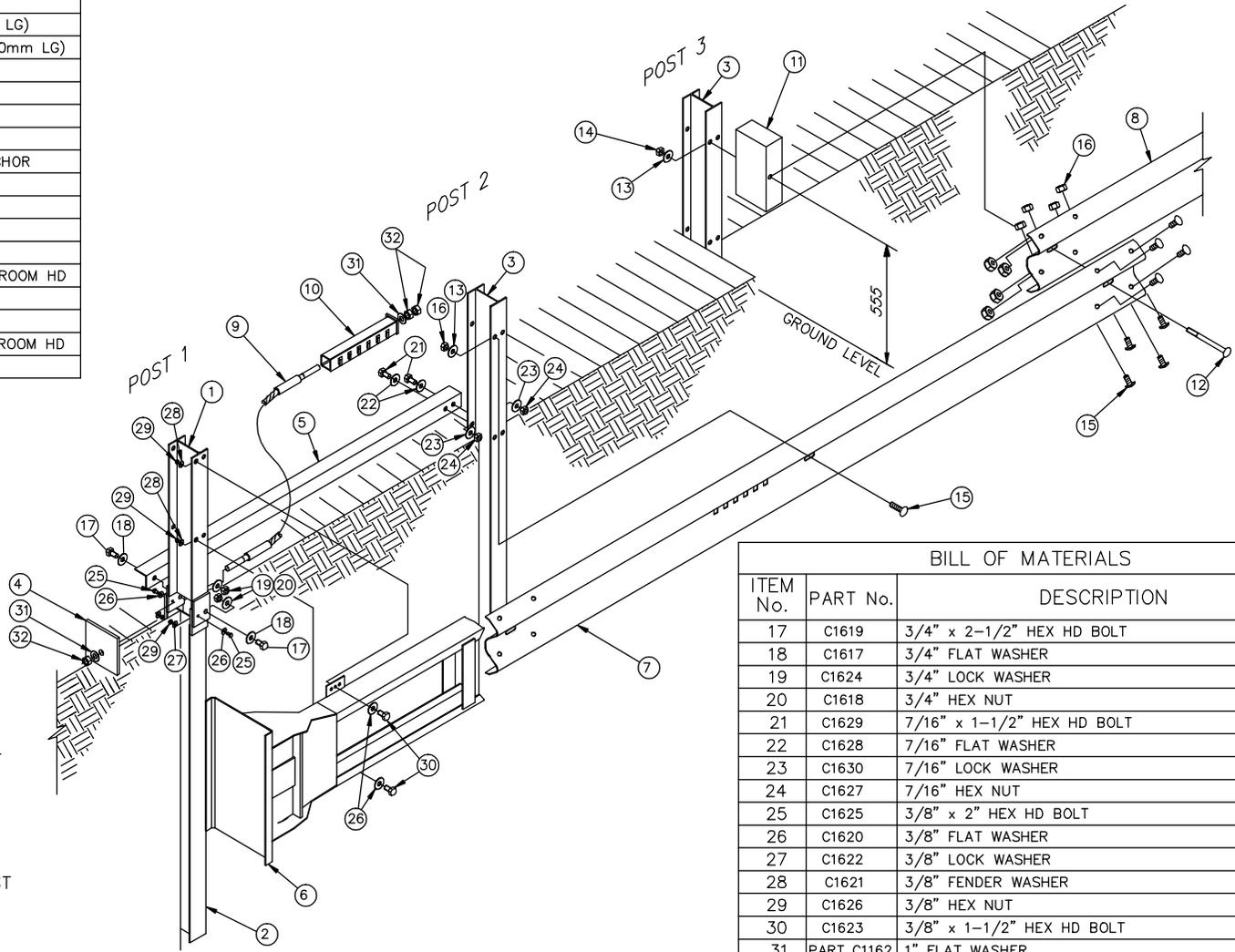
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|-----|-------------------------------------|--------|----------|
| E | NOTES ADDED | L.G. | 12/08/14 |
| D | LAYOUT AMENDED | M.S. | 27/10/10 |
| C | AMENDED TITLE BLOCK & DWG CONVERT | M.S. | 03/02/09 |
| B | GENERAL AMENDMENTS | B.F. | 19/5/04 |
| A | HAZARD FREE ZONE & POST DEPTH ADDED | B.F. | 22/3/04 |
| 0 | INITIAL ISSUE | G.P.P. | 4/8/03 |

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| | |
|---------|---|
| PROJECT | ET-2000 PLUS STEEL YIELDING TERMINAL POST SYSTEM NCHRP 350 TEST LEVEL 3 |
| TITLE | GUARDRAIL EXTRUDER TERMINAL SITE PLAN |

| | | |
|-----------------|--------------|----------------------|
| DATE | 27/10/10 | INGAL CIVIL PRODUCTS |
| DRAWN | M.S. | PART No. |
| DESIGNED | TRINITY IND. | |
| CHECKED | G.P.P. | ISSUE No. |
| MATERIALS SHOWN | | CAB-STD-61 |
| FINISH | H.D.GALV. | REV.E |
| SCALE | 1:50 (A3) | |

| BILL OF MATERIALS | | |
|-------------------|----------|--|
| ITEM No. | PART No. | DESCRIPTION |
| 1 | C1793G | HBA TOP POST - POST 1 (830mm LG) |
| 2 | C1794G | HBA BOTTOM POST - POST 1 (1850mm LG) |
| 3 | C1796G | SYT POST - POST 2 & 3 |
| 4 | C1479G | BEARING PLATE (200 x 200 x 16) |
| 5 | C1798G | ANGLE STRUT |
| 6 | C1812G | EXTRUDER HEAD |
| 7 | C1811G | 1ST RAIL 3.81m PUNCHED FOR ANCHOR |
| 8 | C1355G | W-BEAM RAIL 3.81m NLL |
| 9 | C1162 | 2m CABLE ASSEMBLY |
| 10 | C1813G | CABLE ANCHOR FITTING |
| 11 | C1797 | KING BLOCK (190mm WIDE) |
| 12 | C1633 | 5/8" x 10" LG. POST BOLT - MUSHROOM HD |
| 13 | C1631 | 5/8" FLAT WASHER |
| 14 | C1632 | 5/8" HEX NUT |
| 15 | C1550 | M16 x 32LG. SPLICE BOLT - MUSHROOM HD |
| 16 | C1520 | M16 OVERSIZED NUT |



DRIVING DEPTH DETAIL FOR POST 1
SCALE 1:100

| BILL OF MATERIALS | | |
|-------------------|------------|----------------------------|
| ITEM No. | PART No. | DESCRIPTION |
| 17 | C1619 | 3/4" x 2-1/2" HEX HD BOLT |
| 18 | C1617 | 3/4" FLAT WASHER |
| 19 | C1624 | 3/4" LOCK WASHER |
| 20 | C1618 | 3/4" HEX NUT |
| 21 | C1629 | 7/16" x 1-1/2" HEX HD BOLT |
| 22 | C1628 | 7/16" FLAT WASHER |
| 23 | C1630 | 7/16" LOCK WASHER |
| 24 | C1627 | 7/16" HEX NUT |
| 25 | C1625 | 3/8" x 2" HEX HD BOLT |
| 26 | C1620 | 3/8" FLAT WASHER |
| 27 | C1622 | 3/8" LOCK WASHER |
| 28 | C1621 | 3/8" FENDER WASHER |
| 29 | C1626 | 3/8" HEX NUT |
| 30 | C1623 | 3/8" x 1-1/2" HEX HD BOLT |
| 31 | PART C1162 | 1" FLAT WASHER |
| 32 | PART C1162 | 1" HEX NUT |

CAD FILE - CAB-STD-063.DWG 10/02/04

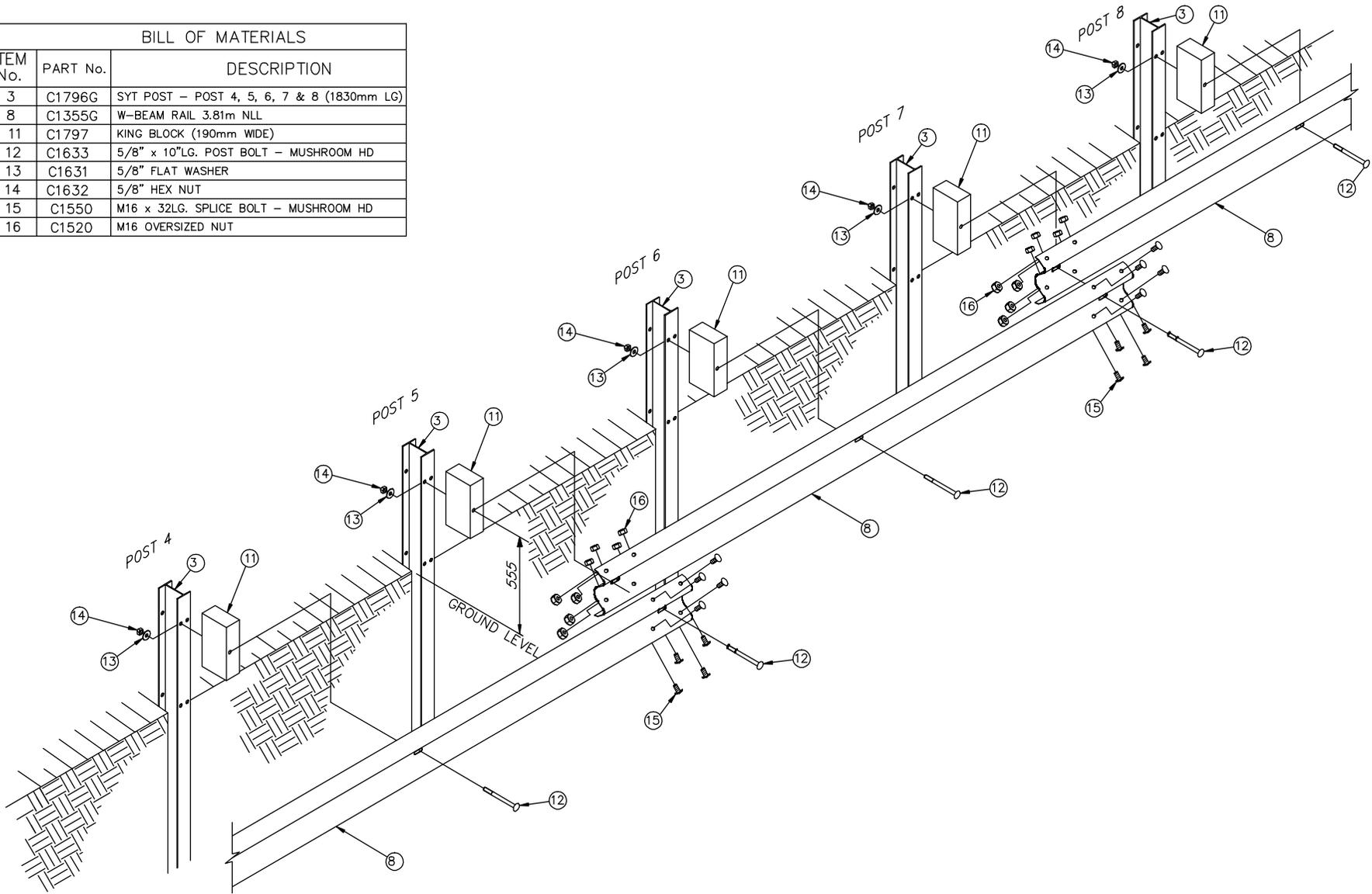
| Rev | Description | Chkd | Date |
|-----|------------------------------------|------|----------|
| C | TITLE BLOCK UPDATED | MS | 24/02/09 |
| B | ITEM 11 DESCRIPTION AMENDED | BF | 19/05/04 |
| A | LENGTHS ADDED TO BILL OF MATERIALS | BF | 22/03/04 |
| 0 | INITIAL ISSUE | IJ | 10/02/04 |

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PROJECT ET-2000 PLUS NCHRP TEST LEVEL 3
 STEEL YIELDING TERMINAL POST SYSTEM
 TITLE GUARDRAIL EXTRUDER TERMINAL
 POSTS 1, 2 & 3 ASSEMBLY DRAWING

| | |
|-----------------------|---------------------------------------|
| DATE 10/02/04 | INGAL CIVIL PRODUCTS REFERENCE No. |
| DRAWN B.F | |
| DESIGNED TRINITY IND. | |
| CHECKED IJ | |
| MATERIAL AS SHOWN | DRAWING No. |
| FINISH H.D GALV | CAB-STD-063 |
| SCALE 1:250 (A3) | REV.C |

| BILL OF MATERIALS | | |
|-------------------|----------|--|
| ITEM No. | PART No. | DESCRIPTION |
| 3 | C1796G | SYT POST - POST 4, 5, 6, 7 & 8 (1830mm LG) |
| 8 | C1355G | W-BEAM RAIL 3.81m NLL |
| 11 | C1797 | KING BLOCK (190mm WIDE) |
| 12 | C1633 | 5/8" x 10" LG. POST BOLT - MUSHROOM HD |
| 13 | C1631 | 5/8" FLAT WASHER |
| 14 | C1632 | 5/8" HEX NUT |
| 15 | C1550 | M16 x 32LG. SPLICE BOLT - MUSHROOM HD |
| 16 | C1520 | M16 OVERSIZED NUT |



| Rev | Description | Chkd | Date |
|-----|------------------------------------|------|----------|
| C | TITLE BLOCK UPDATED | MS | 24/02/09 |
| B | ITEM 11 DESCRIPTION AMENDED | BF | 19/05/04 |
| A | LENGTHS ADDED TO BILL OF MATERIALS | BF | 22/03/04 |
| 0 | INITIAL ISSUE | IJ | 10/02/04 |

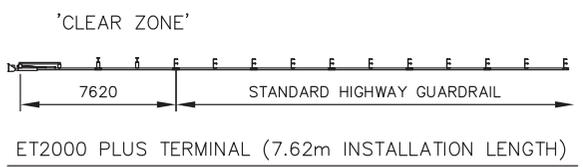
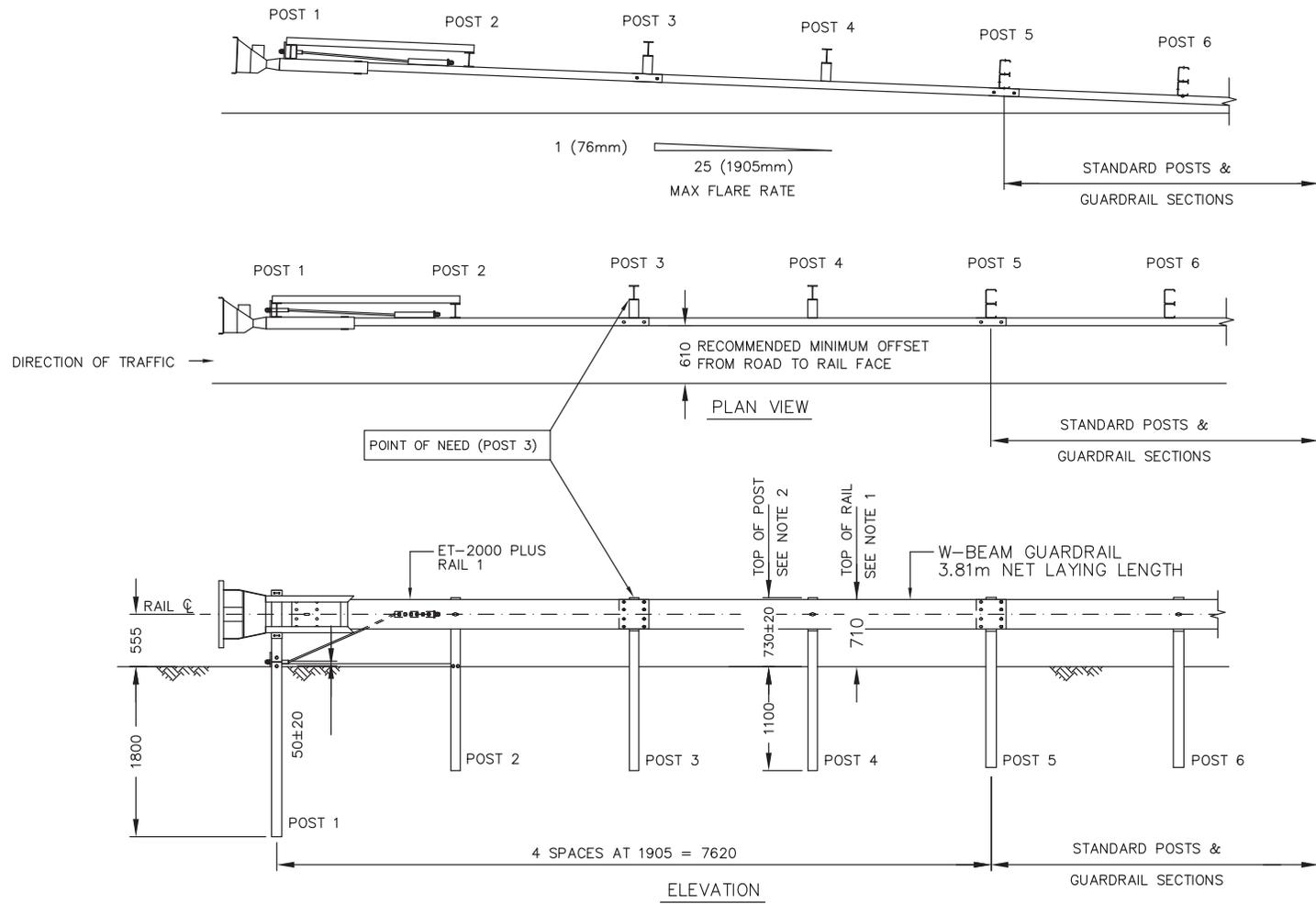
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PROJECT ET-2000 PLUS NCHRP TEST LEVEL 3
 STEEL YIELDING TERMINAL POST SYSTEM

TITLE GUARDRAIL EXTRUDER TERMINAL
 POSTS 4,5,6,7 & 8 ASSEMBLY DRAWING

| | |
|-----------------------|------------------------------------|
| DATE 10/02/04 | INGAL CIVIL PRODUCTS REFERENCE No. |
| DRAWN B.F | |
| DESIGNED TRINITY IND. | |
| CHECKED IJ | |
| MATERIALS SHOWN | DRAWING No. |
| FINISH H.D GALV | CAB-STD-064 |
| SCALE 1:250 (A3) | REV.C |



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 2. IF RAIL HEIGHT IS TO BE MODIFIED AS PER NOTE 1, NEW POST HEIGHT SHOULD BE RAIL HEIGHT PLUS 20mm.

| Rev | Description | Chkd | Date |
|-----|---------------------|------|----------|
| C | NOTES ADDED | L.G. | 12/08/14 |
| B | LAYOUT AMENDED | M.S | 27/10/10 |
| A | TITLE BLOCK AMENDED | M.S | 03/02/09 |
| 0 | INITIAL ISSUE | I.J. | 12/5/05 |

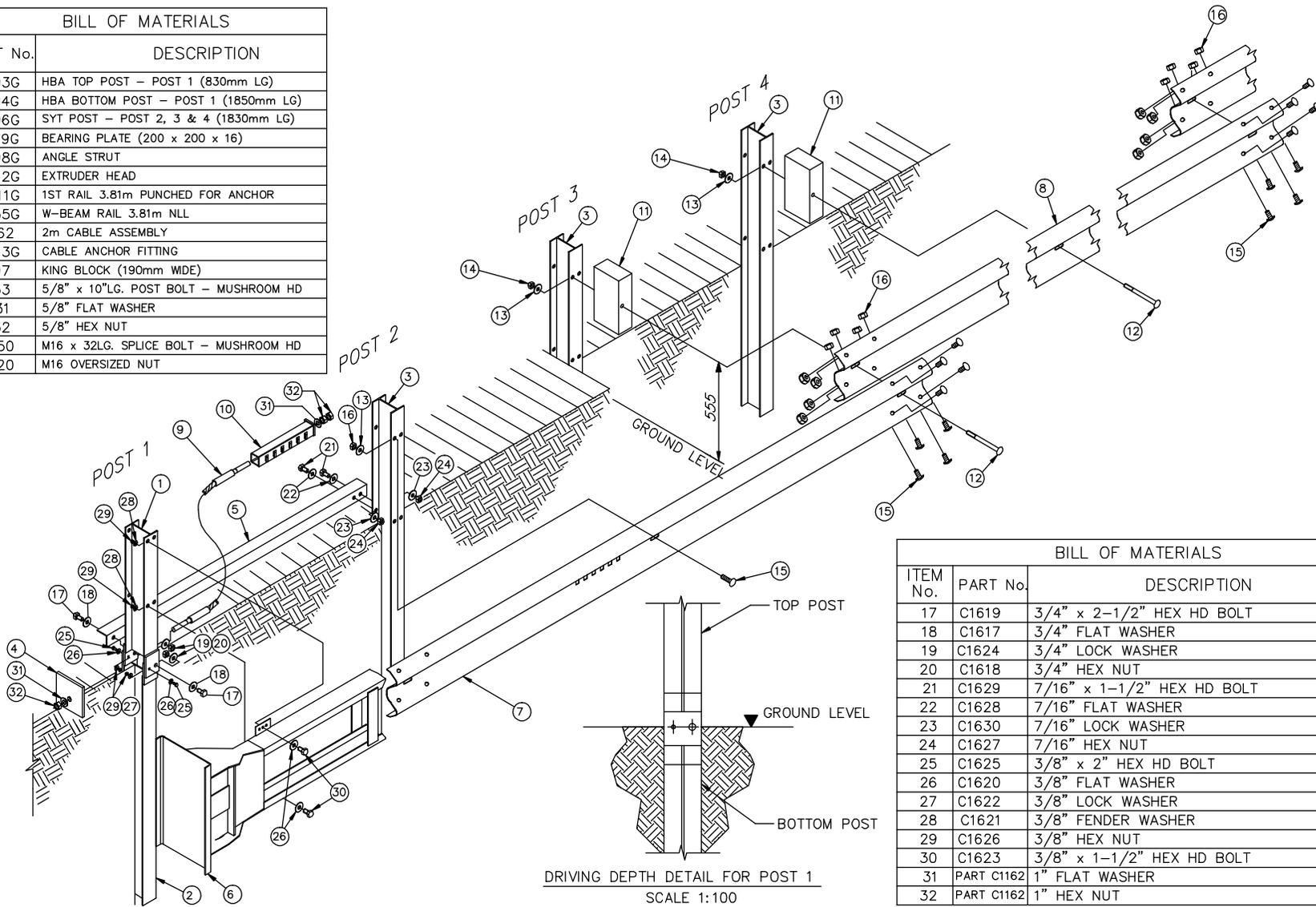
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PROJECT ET-2000 PLUS
 STEEL YIELDING TERMINAL POST SYSTEM
 NCHRP 350 TEST LEVEL 2

TITLE GUARDRAIL EXTRUDER TERMINAL
 SITE PLAN

| | |
|-----------------------|---------------------------------------|
| DATE 27/10/10 | INGAL CIVIL PRODUCTS REFERENCE No. |
| DRAWN M.S | |
| DESIGNED TRINITY IND. | |
| CHECKED I.J. | DRAWING No. |
| MATERIALS SHOWN | CAB-STD-65 |
| FINISH H.D.GALV. | |
| SCALE 1:50 (A3) | |
| | REV.C |

| BILL OF MATERIALS | | |
|-------------------|----------|--|
| ITEM No. | PART No. | DESCRIPTION |
| 1 | C1793G | HBA TOP POST - POST 1 (830mm LG) |
| 2 | C1794G | HBA BOTTOM POST - POST 1 (1850mm LG) |
| 3 | C1796G | SYT POST - POST 2, 3 & 4 (1830mm LG) |
| 4 | C1479G | BEARING PLATE (200 x 200 x 16) |
| 5 | C1798G | ANGLE STRUT |
| 6 | C1812G | EXTRUDER HEAD |
| 7 | C1811G | 1ST RAIL 3.81m PUNCHED FOR ANCHOR |
| 8 | C1355G | W-BEAM RAIL 3.81m NLL |
| 9 | C1162 | 2m CABLE ASSEMBLY |
| 10 | C1813G | CABLE ANCHOR FITTING |
| 11 | C1797 | KING BLOCK (190mm WIDE) |
| 12 | C1633 | 5/8" x 10" LG. POST BOLT - MUSHROOM HD |
| 13 | C1631 | 5/8" FLAT WASHER |
| 14 | C1632 | 5/8" HEX NUT |
| 15 | C1550 | M16 x 32LG. SPLICE BOLT - MUSHROOM HD |
| 16 | C1520 | M16 OVERSIZED NUT |



| BILL OF MATERIALS | | |
|-------------------|------------|----------------------------|
| ITEM No. | PART No. | DESCRIPTION |
| 17 | C1619 | 3/4" x 2-1/2" HEX HD BOLT |
| 18 | C1617 | 3/4" FLAT WASHER |
| 19 | C1624 | 3/4" LOCK WASHER |
| 20 | C1618 | 3/4" HEX NUT |
| 21 | C1629 | 7/16" x 1-1/2" HEX HD BOLT |
| 22 | C1628 | 7/16" FLAT WASHER |
| 23 | C1630 | 7/16" LOCK WASHER |
| 24 | C1627 | 7/16" HEX NUT |
| 25 | C1625 | 3/8" x 2" HEX HD BOLT |
| 26 | C1620 | 3/8" FLAT WASHER |
| 27 | C1622 | 3/8" LOCK WASHER |
| 28 | C1621 | 3/8" FENDER WASHER |
| 29 | C1626 | 3/8" HEX NUT |
| 30 | C1623 | 3/8" x 1-1/2" HEX HD BOLT |
| 31 | PART C1162 | 1" FLAT WASHER |
| 32 | PART C1162 | 1" HEX NUT |

| Rev | Description | Chkd | Date |
|-----|---------------------|------|----------|
| A | TITLE BLOCK UPDATED | MS | 24/02/09 |
| 0 | INITIAL ISSUE | JJ | 10/02/04 |



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| | |
|---------|--|
| PROJECT | ET-2000 PLUS NCHRP TEST LEVEL 2 STEEL YIELDING TERMINAL POST SYSTEM |
| TITLE | GUARDRAIL EXTRUDER TERMINAL POSTS 1, 2, 3 & 4 ASSEMBLY DRAWING |

| | | |
|-----------------|--------------|--|
| DATE | 12/05/05 | INGAL CIVIL PRODUCTS REFERENCE No. |
| DRAWN | B.F | |
| DESIGNED | TRINITY IND. | DRAWING No. CAB-STD-067 REV.A |
| CHECKED | IJ | |
| MATERIALS SHOWN | | |
| FINISH | H.D GALV | |
| SCALE | 1:250 (A3) | |



For more information



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- Melbourne • Newcastle
- Perth • Sydney • Wagga