January 28, 2004

Refer to: HSA-10/CC-86

Mr. Derek W. Muir
Group Managing Director, Hill & Smith Ltd.
Springvale Avenue, Bilston
Wolverhampten, WV14 OQL
West Midlands, United Kingdom

Dear Mr. Muir:

On December 16, 2003, Dr. Richard G. McGinnis, your consultant, and Mr. Jerry Emerson, representing BRIFEN USA, presented members of my staff with the final design details and crash test reports for a proprietary end terminal for use with the BRIFEN Wire Rope Safety Fence. All testing was done at the Motor Industry Research Association (MIRA) located at Nuneaton, United Kingdom. Tests designated as National Cooperative Highway Research Program Report 350 tests 3-30, 3-34, 3-35, and 3-39 were successfully completed. In previous discussions between Dr. McGinnis and members of my staff, it was mutually agreed that for your specific terminal design, tests 3-31, 3-32, and 3-33 could be waived if no concerns were noted in any of the remaining tests.

Your terminal, called the BRIFEN Wire Rope Gating Terminal (WRGT), interweaves each of the four BRIFEN cables around four anchor posts (Type A, B1, B2, and B3) having an "S" (or "Z") shape cross section and into an angled steel bracket set in a 1220-mm diameter by 914-mm deep concrete foundation. The overall layout, including post designs, spacing and detailed dimensions are shown in enclosures 1 through 5. Existing BRIFEN terminals may be retrofitted with the crashworthy design. A retrofit would require replacement of the 15 posts immediately adjacent to each anchor with the non-slotted length of need (LON) posts shown in enclosure 5. The four cables would then be woven around each post until reaching the original slotted LON posts where the top cable would be set in the slot in the top of each post. For new installations, the
4-mm thick non-slotted post may be used in place of the original 6-mm thick slotted post throughout the barrier LON. For design purposes, the dynamic deflection of the BRIFEN with 4-mm line posts may be assumed to be 2.5 meters, slightly greater than the test results with the 6-mm thick line posts. For test 3-35, the line posts were oriented so the "sharp" edges of the "S" posts were facing the test vehicle, an expected worst-case situation. I understand that your recommended orientation for field installations is to set these posts so the curved edge faces approach traffic, but agree that either orientation is acceptable.

All tests were conducted on a 100-m long installation, excluding the 7.75-m length of the terminal itself. As with all gating, non-energy absorbing terminals, impacts at or near the end of the WRGT will allow a vehicle to travel a significant distance behind and beyond the barrier, a factor that must be considered in the design and layout of the barrier installation. In cases where penetration behind the terminal is not acceptable (i.e., where significant vehicular intrusion may have severe consequences) and the barrier cannot be extended, an energy-absorbing crash cushion remains a feasible alternative. In test 3-35, the pickup truck struck the rail approximately 1600-mm upstream from the first line post or 9,350-mm downstream from the terminal end. Consequently, this point should be considered the beginning of the barrier LON. The results of each test are summarized in Enclosures 6 through 9.

Based on the results of these tests, the BRIFEN WRGT meets all evaluation criteria for a test level 3 terminal. Therefore, it may be used on the National Highway System (NHS) when selected by the appropriate transportation agency. You will be expected to certify that any hardware you furnish has essentially the same chemistry, mechanical properties, and geometry as that tested, and to provide users with sufficient information on design and installation requirements to ensure proper performance.

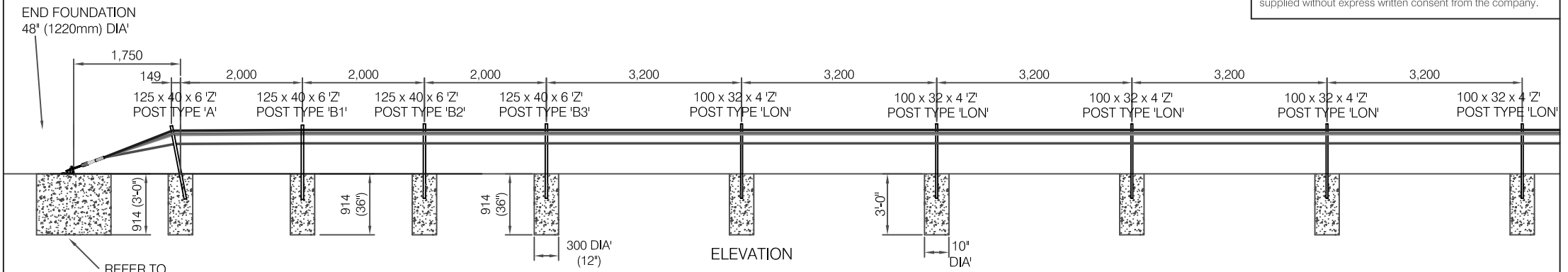
Any agency interested in a BRIFEN WRSF installation may obtain additional information from your website at www.brifenusa.com. As noted in the Federal Highway Administration's February 27, 2003, acceptance letter B-82A, the BRIFEN system is currently manufactured in the United States from U.S. steel and is no longer subject to the "Buy America" provisions of Title 23 Code of Federal Regulations, Section 635.410. Because it is still a proprietary product, its use on the NHS must continue to comply with Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,

/***Original Signed By***/

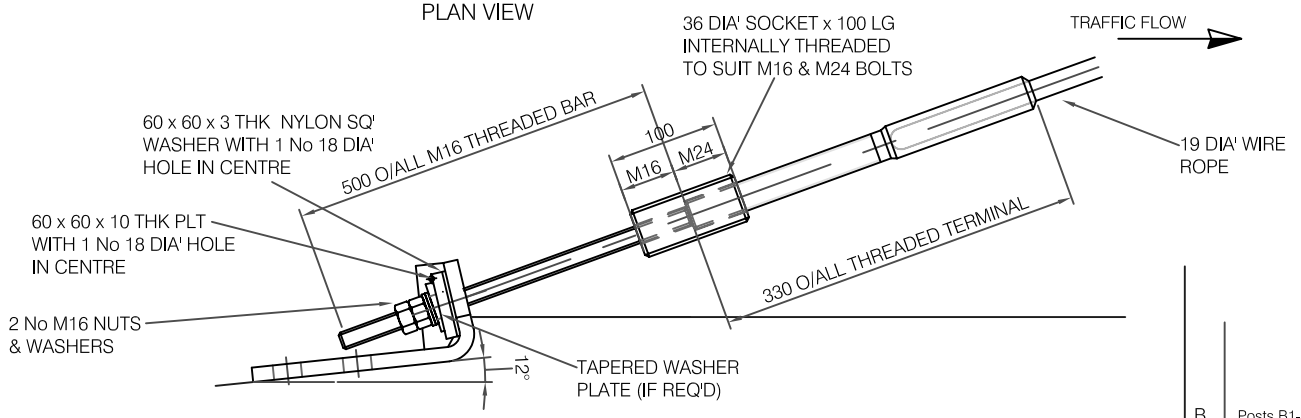
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

9 Enclosures



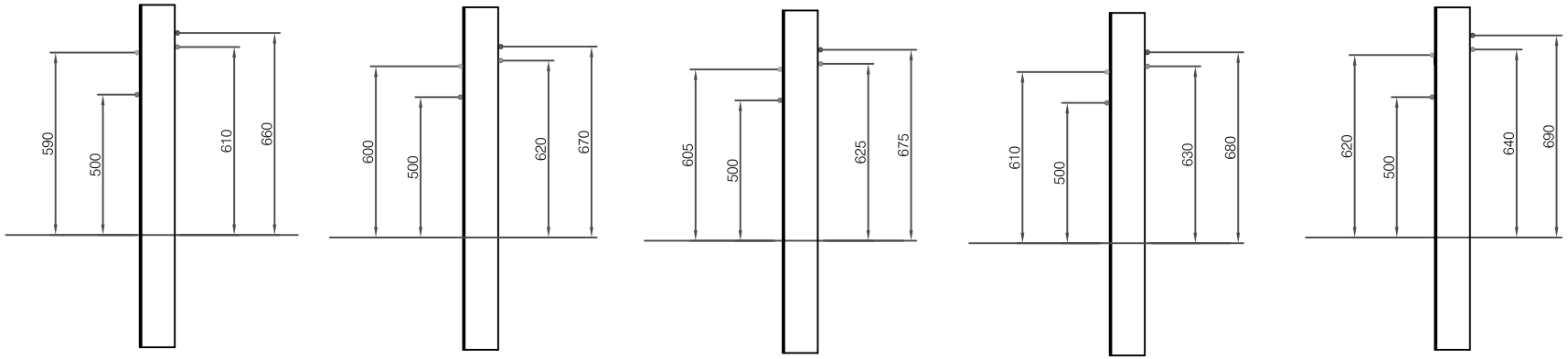
ELEVATION

PLAN VIEW



TYPICAL DETAIL AT ANCHORAGE

NOTE.
TOLERANCES :
ROPE HEIGHTS - ±30
POST CENTRES - ±30
FOUNDATIONS - +50
-0



POST TYPE 'A'
125 x 40 x 6 'Z' (HOOKS)

POST TYPE 'B1'
125 x 40 x 6 'Z' (ROLLERS)

POST TYPE 'B2'
125 x 40 x 6 'Z' (ROLLERS)

POST TYPE 'B3'
125 x 40 x 6 'Z' (ROLLERS)

POST TYPE 'LON'
100 x 32 x 4 'Z' (ROLLERS)

Rev'	Remarks	E.C.O.	Date
B	Posts B1-B3 Details Added		12/03
A	Amended to suit Consultants comments		12/03

Drawn By	Date	Material
ATWright	Oct' 2003	
Scale	Finish	Weight

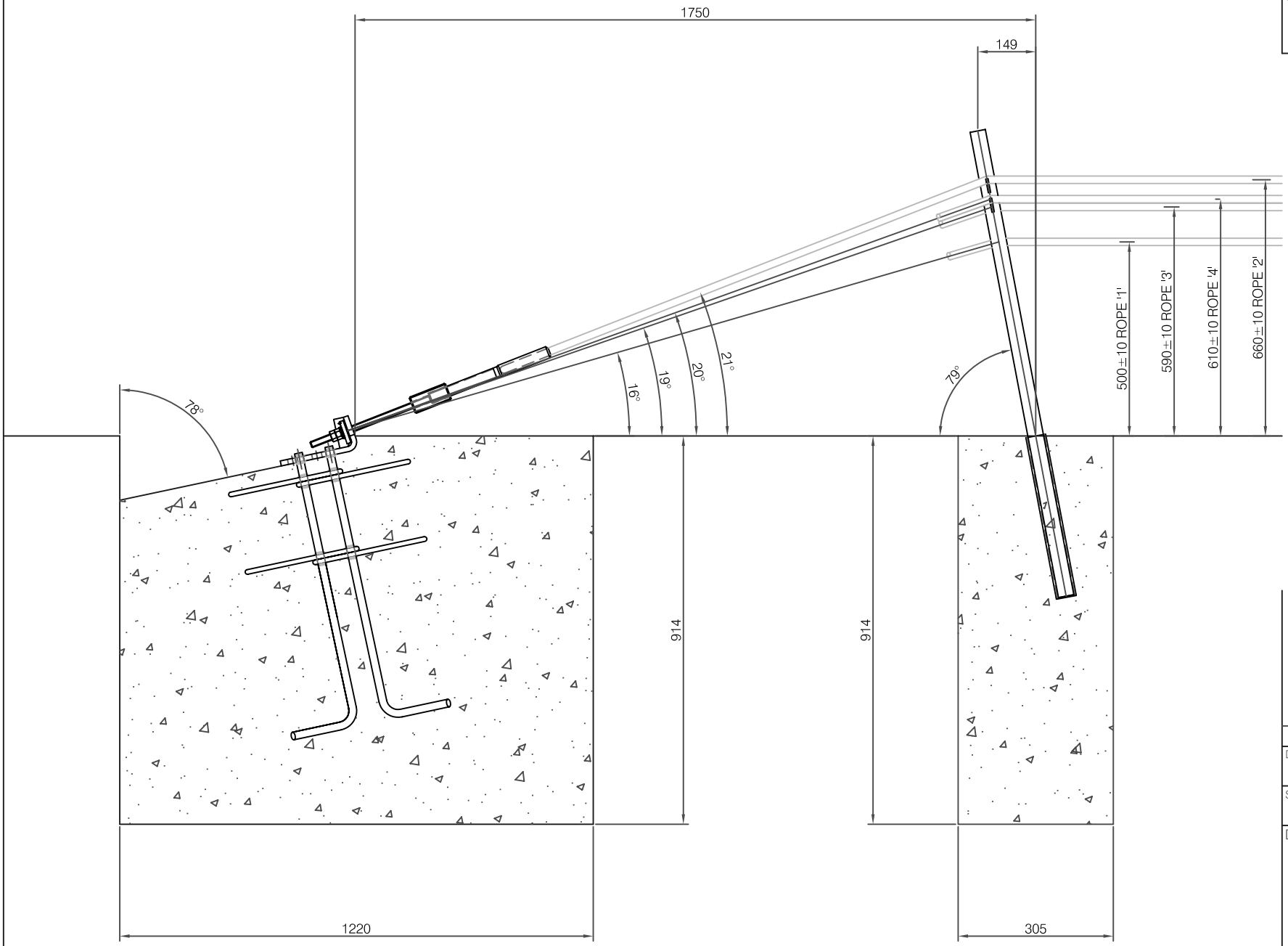
Description

Layout Details of NCHRP 350
Wire Rope Gating Terminal

BRIFEN★USA INC.

Drawing No.
WRSF-03-001b

1. Provision to drain the 'Approach' face of the anchor block of ponding water shall be made.
2. Sockets shall be covered to exclude water.
3. Concrete shall have minimum crush strength of 40 N/mm^2 for terminal foundations.



Rev'	Remarks	E.C.O.	Date
B	Imperial Dims altered to Metric		01/04
A	Amended to suit Consultants commments		12/03

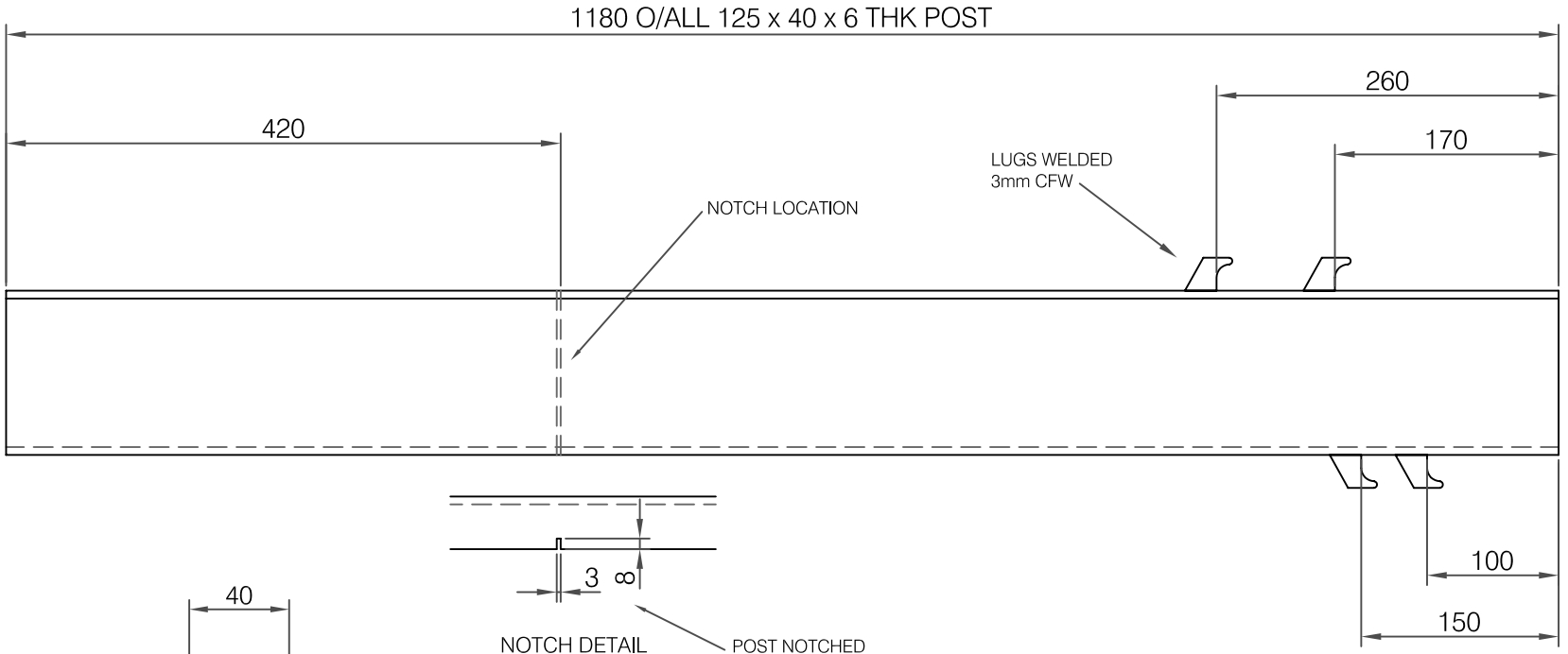
Drawn By	Date	Material
AFWright	Oct' 2003	
Scale	Finish	Weight

Description

End Terminal Details of NCHRP 350
Wire Rope Gating Terminal

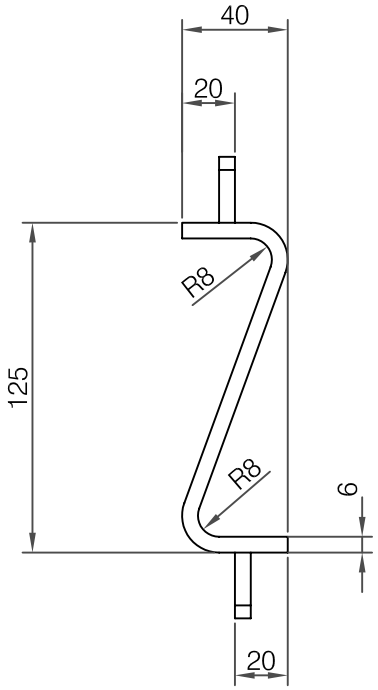
BRIFEN★USA INC.

Drawing No.
WRSF-03-002 b

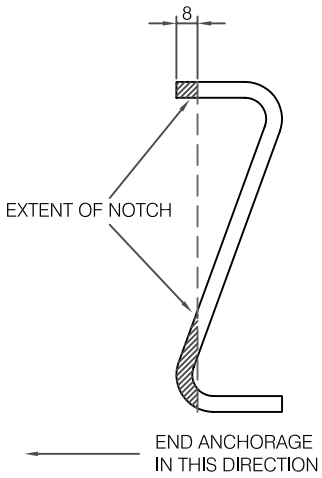


NOTCH DETAIL

POST NOTCHED
(NOTCH MUST ALWAYS BE
TOWARDS END ANCHORAGE)



SECTION THRO'



SECTION LOCAL TO NOTCH

Rev'	Remarks	E.C.O.	Date
B	Notch Detail Clarified		12/03
A	Hook Position Amended		12/03

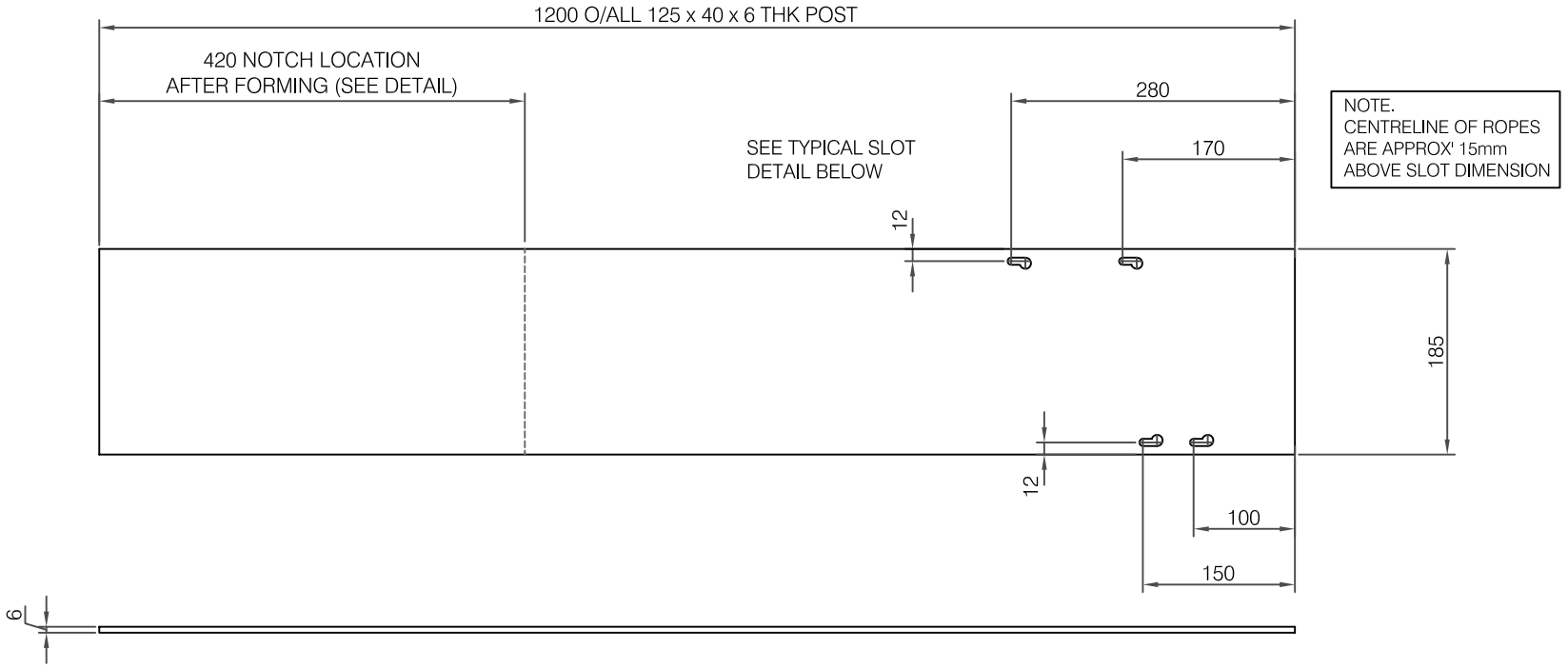
Drawn By: ATWright	Date: Oct 2003	Material: ASTM A572-00 GRADE 50
Scale: N.T.S.	Finish: ASTM 123	Weight:

Description

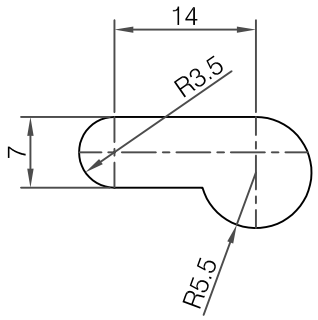
Details of 1180 x 6 Thk 125 x 40
Line Post Type 'A'
NCHRP 350 Gating Terminal.

BRIFEN★USA INC.

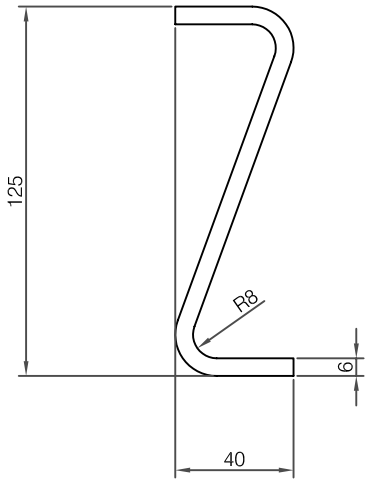
Drawing No.
WRSF-03-007 b



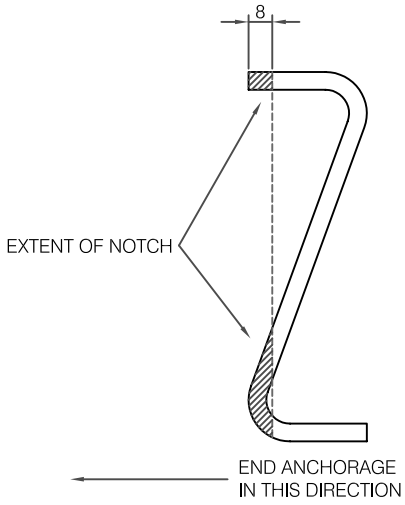
WIRE ROPE LINE POST (BLANK)



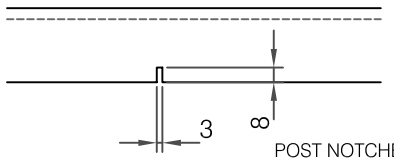
TYPICAL SLOT DETAIL



TYPICAL TOP VIEW



SECTION LOCAL TO NOTCH



POST NOTCHED
(NOTCH MUST ALWAYS BE
TOWARDS END ANCHORAGE)

NOTCH DETAIL

Rev'	Remarks	E.C.O.	Date
B	Notch Detail Clarified		12/03
A	Amended to suit Consultants comments		12/03

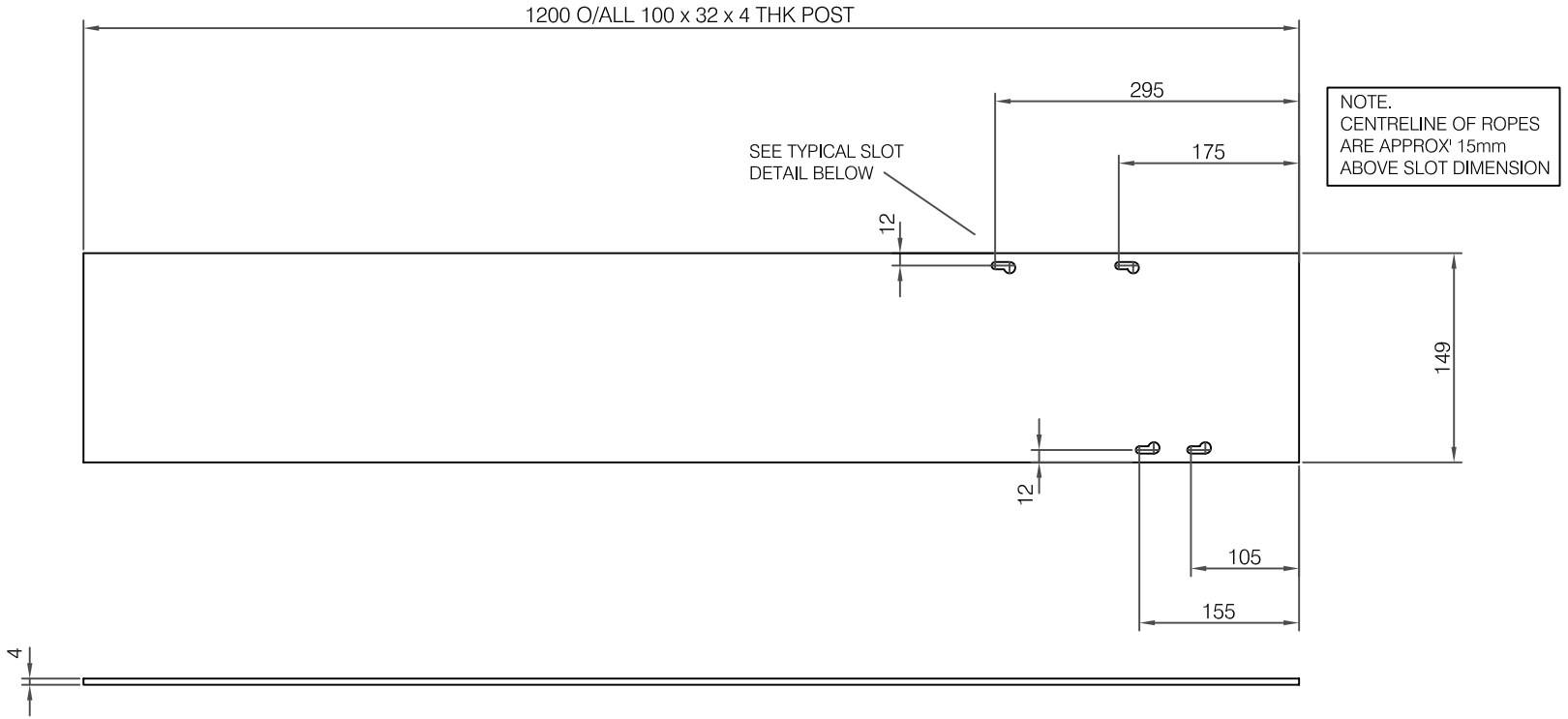
Drawn By: *ATWright*	Date: Oct' 2003	Material: ASTM A572-00 GRADE 50
Scale: N.T.S.	Finish: ASTM 123	Weight:

Description

Details of 1180 x 6 Thk 125 x 40
Line Post Types 'B1' 'B2' & 'B3'
NCHRP 350 Gating Terminal.

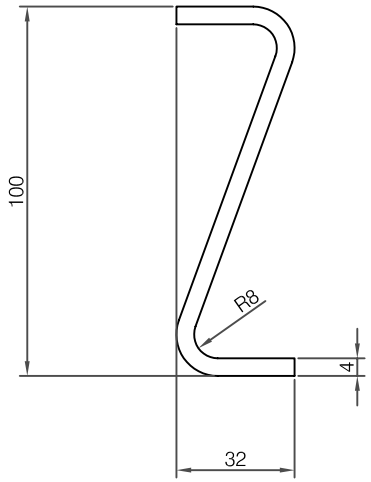
BRIFEN★USA INC.

Drawing No. WRSF-03-008 b

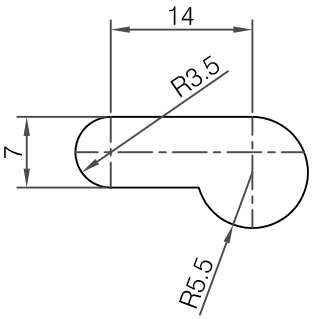


NOTE.
CENTRELINE OF ROPES
ARE APPROX' 15mm
ABOVE SLOT DIMENSION

WIRE ROPE LINE POST (BLANK)



TYPICAL TOP VIEW



TYPICAL SLOT DETAIL

Rev'	Remarks	E.C.O.	Date

Drawn By	Date	Material
ATWright	Dec' 2003	
Scale	**Finish**	**Weight**
N.T.S.		

Description

Details of 1200 x 4 Thk 100 x 32
Line Post Type 'LON'.
NCHRP 350 Wire Rope Gating
Terminal.

BRIFEN★USA INC.

Drawing No.
WRSF-03-018

3 Assessment and Conclusions

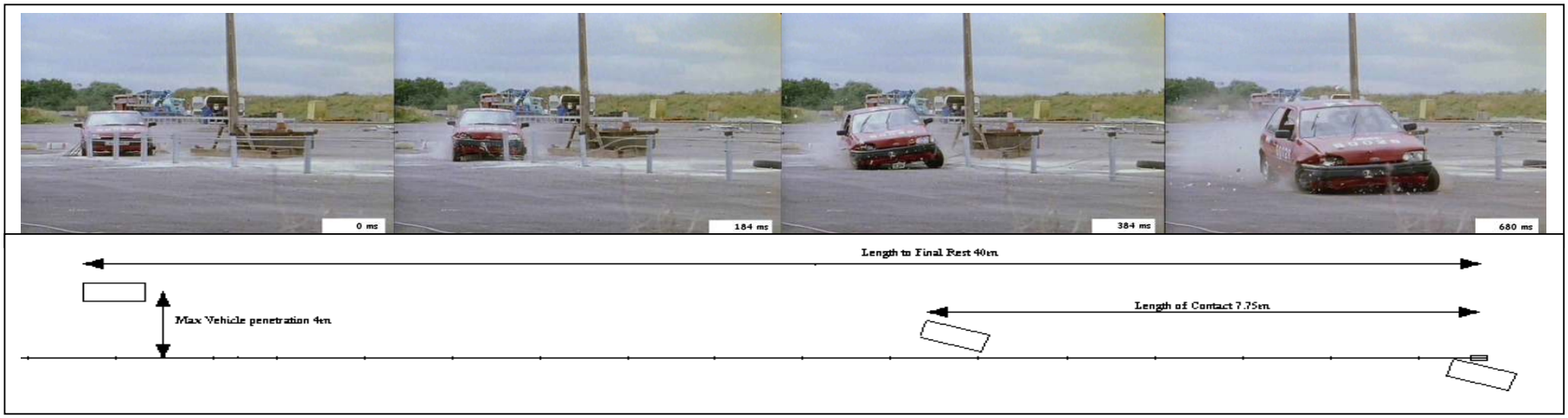
3.1 Summary of Test Results

General Information		**Impact Conditions**		**Test Article Deflections**	(Deflection of Traffic face)
Test Agency	MIRA Ltd	Speed (km/h)	100.9 km/h	Dynamic (m)	**N/a**
Test No	B0035	Angle (deg)	0 deg	Permanent (m)	**N/a**
Date	11 September 2003	**Exit Conditions**		Vehicle Penetration (m)	N/a
Test Article		Speed (km/h)	Not measured	**Vehicle Damage – Exterior**	
Type	Brifen Cable Guardrail Terminal	Angle (deg)	N/a	VDS	Not Measured
Installation Length (m)	100m (nom)	**Occupant Risk Values**		CDC	Not Measured
Size and/or dimension and	Steel 'S' Posts	Impact Velocity (m/s) x-direction	2.45	**Vehicle Damage – Interior**	
Soil Type and Condition	Standard Soil, Dry	Impact Velocity (m/s) y-direction	-1.30	OCDI	AS0000000
Test Vehicle		THIV (optional) (m/s)	2.67		
Type	3 Door	Ride-down Acceleration x-direction (g)	2.95	**Post Impact Vehicular**	
Designation	Ford	Ride-down Acceleration y-direction (g)	-1.58	Maximum Roll Angle (deg)	38.9
Model	Fiesta	PHD (optional) (g)	3.43	Maximum Pitch Angle (deg)	Not measured
Mass Curb (kg)		ASI (optional)	0.39	Maximum Yaw Angle (deg)	20.7
Test Inertial (kg)	837				
Dummy (s) (kg)	75 (nom)				
Gross Static (kg)	897				

Figure 9: Summary of Results for Test MIRA-03-1003037 (B0035), NCHRP Report 350, test 3-30.

3 Assessment and Conclusions

3.1 Summary of Test Results



General Information			**Impact Conditions**		**Test Article**	(Deflection of Traffic face)
Test Agency		MIRA Ltd	Speed (km/h)	99.0 km/h	Dynamic (m)	**N/a**
Test No		B0028	Angle (deg)	14 deg	Permanent (m)	**N/a**
Date		31 July 2003	**Exit Conditions**		Vehicle Penetration (m)	4.0 m
Test Article			Speed (km/h)	Not measured	**Vehicle Damage –**	
Type		Brifen Cable Guardrail Terminal	Angle (deg)	-13.5 deg (ie behind fence)	VDS	Not Measured
Installation Length (m)		100m (nom)	**Occupant Risk Values**		CDC	Not Measured
Size and/or dimension and		Steel 'S' Posts	Impact Velocity (m/s) x-direction	3.53	**Vehicle Damage –**	
Soil Type and Condition		Standard Soil, Dry	Impact Velocity (m/s) y-direction	-0.22	OCDI	AS0000000
Test Vehicle			THIV (optional) (m/s)	3.54		
Type		3 Door	Ride-down Acceleration x-direction (g)	4.70	**Post Impact Vehicular**	
Designation		Ford	Ride-down Acceleration y-direction (g)	-1.63	Maximum Roll Angle	-13.0
Model		1993 Fiesta	PHD (optional) (g)	5.61	Maximum Pitch Angle	Not measured
Mass	Curb (kg)	N/a	ASI (optional)	0.44	Maximum Yaw Angle	32.4
	Test Inertial (kg)	839				
	Dummy (s) (kg)	75 (nom)				
	Gross Static (kg)	893				

Figure 9: Summary of Results for Test MIRA-03-1002630 (B0028), NCHRP Report 350, test 3-34.

3 Assessment and Conclusions

3.1 Summary of Test Results

General Information			**Impact Conditions**		**Test Article Deflections**	(Deflection of Traffic face)	
Test Administration		MIRA Ltd	Speed (km/h)	99.4 km/h	Dynamic (m)	**2.0m**	
Test No		B0022	Angle (deg)	23.0 deg	Permanent (m)	**N/a**	
Date		29 August 2003	**Exit Conditions**		Vehicle Penetration (m)	2.0 m	
Test Article			Speed (km/h)	Not measured	**Vehicle Damage –**		
Type		Brifen Cable Guardrail Terminal	Angle (deg)	10.0 deg	VDS	Not Measured	
Installation Length (m)		100m (nom)	**Occupant Risk Values**		CDC	Not Measured	
Size and/or dimension and		Steel 'S' Posts	Impact Velocity (m/s) x-direction	2.21	**Vehicle Damage – Interior**		
Soil Type and Condition		Standard Soil, Dry	Impact Velocity (m/s) y-direction	3.74	OCDI	AS0000000	
Test Vehicle			THIV (optional) (m/s)	4.18			
Type		3 Door	Ride-down Acceleration x-direction (g)	0.85	**Post Impact Vehicular**		
Designation		1999 Chevrolet	Ride-down Acceleration y-direction (g)	3.12	Maximum Roll Angle (deg)	-6.2	
Model		2500 Pick-up	PHD (optional) (g)	3.22	Maximum Pitch Angle	Not measured	
Mass	Curb (kg)		ASI (optional)	0.38	Maximum Yaw Angle (deg)	20.0	
	Test Inertial (kg)	2045					
	Dummy (s) (kg)	N/a					
	Gross Static (kg)	2045					

Figure 9: Summary of Results for Test MIRA-03-1002263 (B0022), NCHRP Report 350, test 3-35.

3 Assessment and Conclusions

3.1 Summary of Test Results

General Information		**Impact Conditions**		**Test Article Deflections**	(Deflection of Traffic face)
Test Agency	MIRA Ltd	Speed (km/h)	101.5	Dynamic (m)	3.0 (disconnected ropes)
Test No	B0027	Angle (deg)	21.5	Permanent (m)	N/a
Date	5 Aug 2003	**Exit Conditions**		Vehicle Penetration (m)	0.88
Test Article		Speed (km/h)	Not recorded	**Vehicle Damage –**	
Type	Brifen Cable Guardrail Terminal	Angle (deg)		VDS	Not Measured
Installation Length (m)	100m (nom)	**Occupant Risk Values**		CDC	Not Measured
Size and/or dimension and	Steel 'S' Posts	Impact Velocity (m/s) x-direction	5.79	**Vehicle Damage – Interior**	
Soil Type and Condition	Standard Soil, Dry	Impact Velocity (m/s) y-direction	-0.28	OCDI	AS0000000
Test Vehicle		THIV (optional) (m/s)	5.79		
Type	3 Door	Ride-down Acceleration x-direction (g)	6.96	**Post Impact Vehicular**	
Designation	Ford	Ride-down Acceleration y-direction (g)	-2.69	Maximum Roll Angle (deg)	12.4
Model	1995 Fiesta	PHD (optional) (g)	9.52	Maximum Pitch Angle	Not measured
Mass Curb (kg)	Not recorded	ASI (optional)	0.73	Maximum Yaw Angle (deg)	41.9
Test Inertial (kg)	837				
Dummy (s) (kg)	75 (nom)				
Gross Static (kg)	898				

Figure 9: Summary of Results for Test MIRA-03-1002662 (B0027), NCHRP Report 350, test 3-39.