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**RENDERED TO**

**EXCELL RAILING SYSTEM  
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**PRODUCT EVALUATED:**  
Excell Welded Picket & Glass Railing System and Durarail Welded Picket &  
Glass Railing System  
**EVALUATION PROPERTY:**  
2006 International Building Code, Section 1607.7.1

**Engineering Evaluation of Excell Welded Picket & Glass Railing System  
and Durarail Welded Picket & Glass Railing System for compliance with  
the applicable requirements of the following criteria: 2006 International  
Building Code, Section 1607.7.1**

**ENGINEERING EVALUATION**

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## 1 Introduction

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Intertek has conducted an engineering evaluation for Excell Railing System, on the Excell Welded Picket & Glass Railing System and Durarail Welded Picket & Glass Railing System, to evaluate the interchangeability of 3 types of top rails. The evaluation was conducted to determine if the testing performed on the 2-piece round top rail, will show equivalency for the use of the other top rails in accordance with the 2006 International Building Code, Section 1607.7.1.

## 2 Sample and Assembly Description

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Intertek has tested the following 2 railing systems in full accordance with the load requirements of the 2006 IBC, Section 1607.7.1:

### System 1 – 6 ft. Durarail 2-Piece Round Welded Picket Railing System

Post: 1.72 in. x 1.72 in. 6061-T6 extruded aluminum post with a 6 in. 6061-T6 post insert

Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes

Top Rails: 42 in. high, 2-piece 6063-T5 aluminum round rail

Picket Insert: 5/8 in. x 5/8 in. 6063-T5 aluminum spaced 4-1/2 in. o/c

### System 2 – 5 ft. Durarail 2-Piece Round Glass In-fill Railing System

Post: 1.72 in. x 1.72 in. 6061-T6 aluminum rail

Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes

Top Rails: 42 in. high, 2-piece 6063-T5 aluminum round rail

Panel Insert: ¼ in. thick tempered glass panel

The following systems have been evaluated to determine if they are equivalent to the systems above and would meet the requirements of the 2006 IBC, Section 1607.7.1:

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System 3 – 6 ft. Durarail 2-Piece Square Welded Picket Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 extruded aluminum post with a 6 in. 6061-T6 post insert
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 2-piece 6063-T5 aluminum square rail
- Picket Insert: 5/8 in. x 5/8 in. 6063-T5 aluminum spaced 4-1/2 in. o/c

System 4 – 5 ft. Durarail 2-Piece Square Glass In-fill Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 aluminum rail
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 2-piece 6063-T5 aluminum square rail
- Panel Insert: ¼ in. thick tempered glass panel

System 5 – 6 ft. Excell 1-Piece Round Welded Picket Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 extruded aluminum post with a 6 in. 6061-T6 post insert
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 1-piece 6063-T5 aluminum round rail
- Picket Insert: 5/8 in. x 5/8 in. 6063-T5 aluminum spaced 4-1/2 in. o/c

System 6 – 5 ft. Excell 1-Piece Round Glass In-fill Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 aluminum rail
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 1-piece 6063-T5 aluminum round rail
- Panel Insert: ¼ in. thick tempered glass panel
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### System 7 – 6 ft. Excell 1-Piece Square Welded Picket Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 extruded aluminum post with a 6 in. 6061-T6 post insert
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 1-piece 6063-T5 aluminum square rail
- Picket Insert: 5/8 in. x 5/8 in. 6063-T5 aluminum spaced 4-1/2 in. o/c

### System 8 – 5 ft. Excell 1-Piece Square Glass In-fill Railing System

- Post: 1.72 in. x 1.72 in. 6061-T6 aluminum rail
- Base Plate (deck): 4 in. x 4 in. x 3/8 in. 6061-T6 aluminum base plate with 4 mounting holes
- Top Rails: 42 in. high, 1-piece 6063-T5 aluminum square rail
- Panel Insert: ¼ in. thick tempered glass panel

Installation details of all 8 railing systems have been provided in Appendix A, along with specifications on each part.

## **3 Reference Documents**

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- 2006 International Building Code (2006 IBC)
  - Intertek Test Report 3155482COQ-001A
  - Intertek Test Report 3155482COQ-001B
  - System Drawings
    - Durarail Welded Picket System w/ 1.72" Posts
    - Durarail Glass System w/ 1.72" Posts
    - Excell Welded Picket System w/ 1.72" Posts
    - Excell Glass System w/ 1.72" Posts
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## 4 Evaluation Method

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Intertek Test Reports 3155482COQ-001A and 3155482COQ-001B for Systems 1 and 2 respectively showed that these systems meet the load requirements stated in Section 1607.7.1 of the 2006 IBC using a factor of safety of 2.5. A safety factor of 4 was applied on the in-fill test on the tempered glass panel in accordance with Section 2407.1.1 of the 2006 IBC. Based on the noted test results, the alternate systems mentioned in Section 2 of this report were evaluated for compliance in accordance with Section 1607.7.1 of the 2006 IBC.

Systems 3 and 4 are identical to Systems 1 and 2 in terms of the components being utilized in the railing system and the installation of the product, with 1 key difference. The top rail used in Systems 1 and 2 consists of a 2-piece round 6063-T5 aluminum rail as detailed in diagram VS-35977A, whereas Systems 3 and 4 use a 2-piece square 6063-T5 aluminum rail as detailed in VS-11725A (see Appendix). Comparing the moment of inertias ( $I_x$ ,  $I_y$ ) for both top rails as detailed in the noted drawings, the square top rail has greater  $I_x$  and  $I_y$  values than that of the round top rail. The maximum bending stress in the top rail is determined following the relationship noted in Equation 1 below.

$$\sigma = \frac{My}{I_n} \quad (\text{Equation 1})$$

Where  $\sigma$  = bending stress  
 $M$  = bending moment  
 $y$  = thickness / 2  
 $I_n$  =  $I_x$  or  $I_y$

Between the round top rail and square top rail systems, for equivalent loads the bending stress experienced in the square top rail would be lower than that experienced by the round top rail. As the bending stress is the failure cause for the top rail, the lower stress experienced by the square rail for equivalent loads means Systems 1 and 2 tested in Intertek Test Report 3155482COQ-001A and 3155482COQ-001B would meet the requirements of Section 1607.7.1 of the 2006 IBC using the 2-piece square top rail detailed in Appendix Drawing VS-11725A.

Systems 5 and 6 are identical to Systems 1 and 2 in terms of all components being utilized in the railing system and the installation of the product with the exception of Systems 5 and 6 incorporating a round 1-piece top rail as opposed to the use of a round 2-piece top rail. The 1-piece round top rails for Systems 5 and 6 are detailed in diagram VH-40827 (see Appendix). Past testing at Intertek of this type of system showed that use of a 2-piece assembly did not allow the top rail and bottom channel to act as a composite section. The independent movement of the 2-piece top rail system decreases the lateral stiffness provided by the top rail to the railing system assembly, allowing greater deflection of the 2-piece top rail under equivalent loads compared to that of the 1-piece system. In addition, comparison of  $I_x$  and  $I_y$  for Systems 5 and 6 shows the 1-piece top rail for Systems 5 and 6 exceeds the  $I_x$  and  $I_y$  for Systems 1 and 2 detailed in VS-35977A. For the reasons noted above, Systems 1 and 2 from Intertek Test Report 3155482COQ-001A and 3155482COQ-001B would meet the requirements of Section 1607.7.1 of the 2006 IBC using the 1-piece round top rails detailed in Appendix Drawing VH-40827.

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Systems 7 and 8 are identical to Systems 1 and 2 in terms of all components being utilized in the railing system and the installation of the product with the exception of Systems 7 and 8 incorporating a square 1-piece top rail as opposed to the use of a round 2-piece top rail. The 1-piece square top rails for Systems 7 and 8 are detailed in diagram VH-38399 (see Appendix). Past testing at Intertek of this type of system showed that use of a 2-piece assembly did not allow the top rail and bottom channel to act as a composite section. The independent movement of the 2-piece top rail system decreases the lateral stiffness provided by top rail to the railing system assembly allowing greater deflection of the 2-piece top rail under equivalent loads compared to that of the 1-piece system. In addition, comparison of  $I_x$  and  $I_y$  for Systems 7 and 8 shows the 1-piece square top rail for Systems 7 and 8 exceeds the  $I_x$  and  $I_y$  of Systems 1 and 2 detailed in VS-35977A. For the reasons noted above, Systems 1 and 2 from Intertek Test Report 3155482COQ-001A and 3155482COQ-001B would meet the requirements of Section 1607.7.1 of the 2006 IBC using the 1-piece square top rails detailed in Appendix Drawing VH-38399.

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## 5 Conclusion

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Intertek has conducted an engineering evaluation for Excell Railing System, on the Excell Welded Picket & Glass Railing System and Durarail Welded Picket & Glass Railing System, to evaluate the interchangeability of 3 types of top rails. The evaluation was conducted to determine if the testing performed on the 2-piece round top rail, will show equivalency for the use of the other top rails in accordance with the 2006 IBC, Section 1607.7.1. The evaluation, as described in Section 5 of this report, shows that the following systems meet the load requirements of Section 1607.7.1 of the 2006 IBC:

- System 1 – 6 ft. Durarail 2-Piece Round Welded Picket Railing System
- System 2 – 5 ft. Durarail 2-Piece Round Glass In-fill Railing System
- System 3 – 6 ft. Durarail 2-Piece Square Welded Picket Railing System
- System 4 – 5 ft. Durarail 2-Piece Square Glass In-fill Railing System
- System 5 – 6 ft. Excell 1-Piece Round Welded Picket Railing System
- System 6 – 5 ft. Excell 1-Piece Round Glass In-fill Railing System
- System 7 – 6 ft. Excell 1-Piece Square Welded Picket Railing System
- System 8 – 5 ft. Excell 1-Piece Square Glass In-fill Railing System

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ATTACHMENTS: Drawings of Durarail & Excell Railing Systems

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