



## Technical Bulletin

No. 003

### Aluminum Window Frames: Paint Failures

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## Introduction

This bulletin presents systemic paint deficiencies noted on aluminum-frame windows installed at an RDH rehabilitation project. Our observations, test methods, and outcomes related to the failed paint are discussed herein.

## Background

RDH is managing construction for a building enclosure rehabilitation of an 11-story residential building in Vancouver, B.C. The rehabilitation includes new cladding, windows, and roof membrane.

Midway through the construction phase, we noted chipped paint on the new window frames. The chipped paint was isolated to the cut edges of the vertical mullion glazing flanges at the horizontal mullion intersection, shown in Figure 1. The damage was not the result of abrasion or impact, due to the sheltered location of the paint chips.



*Figure 1: Typical chipped paint on a vertical mullion at the intersection with the horizontal mullion.*

## Investigation

RDH tested two windows per AAMA 2604 which references ASTM D-3359. Both windows had chipped paint on at least one frame member.



*Figure 2: Example of chipped paint on the left frame member but not the right.*

Per AAMA 2604, a crosshatch pattern was scored using a utility knife to create one hundred, 1mm x 1mm, squares as shown in Figure 3. The test requires standardized Permacell 99 tape applied to the crosshatch area and pulled off rapidly. Failure of the test is defined as removal of any one square of paint from the test area.

Figure 3 shows the grid pattern scored into the paint of a frame member without chipped paint. Figure 4 shows the result of the adhesion test on a frame member with chipped paint.



Figure 3: Cross-hatch pattern as outlined in AAMA 2604. This sample location is on a frame member without chipped paint.

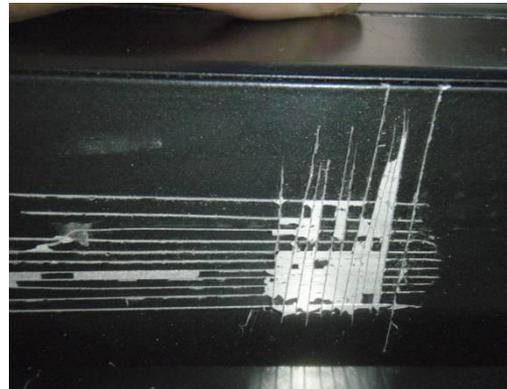


Figure 4: Cross-hatch pattern tested as outlined in AAMA 2604. This sample location is on a window frame member with chipped paint.

The test demonstrated that frame members with chipped paint failed the AAMA 2604 adhesion criteria. The results of RDH's testing justified rejecting windows with chipped paint.

## Cause

The window manufacturer reported that the frame extrusions had been previously painted a different colour for another project but were not made into window frames. The application of an additional primer and finish coat over existing paint contradicts the paint manufacturer's recommendations. Figures 5 and 6 show microscopic views of paint samples retrieved from window frame members that failed the paint adhesion test.

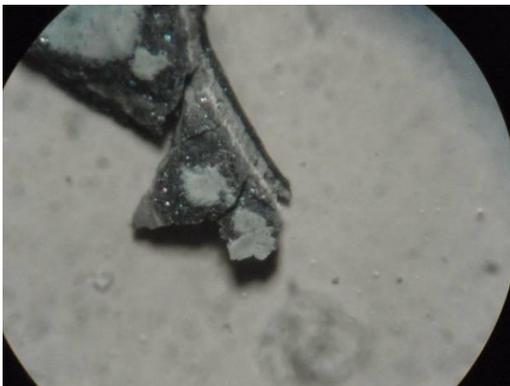


Figure 5: Microscopic view of paint chip samples.

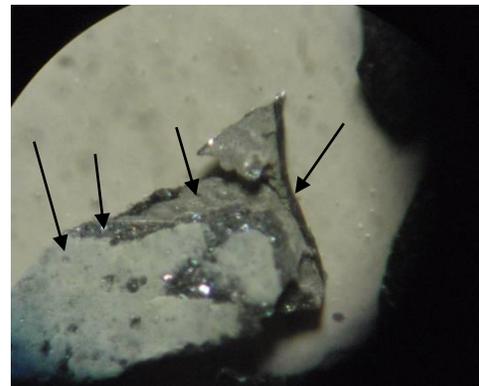


Figure 6: Closer microscopic view of paint chip samples. Note four distinct paint layers.

The frame painting process involves oven heating to cure the paint. The additional heating and cooling cycle likely contributed to the paint failure; however, RDH did not determine the exact cause of the failure.

In the case of this window system, vertical frame extrusions are continuous. Where horizontal members intersect the vertical, the glazing flanges of the vertical are cut to receive the horizontal extrusion. As failures typically occurred at cut edges, we conclude that the cutting process initiated the paint failure of re-painted frames. Under regular (single coat) paint conditions, cutting does not typically cause paint failures.

## Solution

Approximately 60% of the windows on the project included repainted frames with chipped paint. In addition, there was the potential that some frame members were repainted but did not yet show any paint failures.

The window manufacturer determined it was in the best interest of the project to **replace** all of the windows on the building rather than attempt to repair or recoat the frames in the field.

As RDH's details allowed for future window replacement without removing the adjacent cladding, there were minimal delays to the overall construction schedule.

## What to Look for

Windows should be reviewed prior to installation. Minor damage from impact and shipping should be expected; however, if you suspect a paint adhesion issue, here are some things to look for.

- Paint peeling off from the underlying substrate. Look for terminations of the extrusion or places where cuts or other manufacturing processes may have disturbed the paint layer. If the paint is chipped, the edge of a knife or fingernail may be able to pick off the adjacent paint.
- Paint blistering. This may occur anywhere on the extrusion. The tip of a knife will be able to break through a blister if found.
- Other parts of the extrusion. In this case the inner surface of the aluminium extrusion on an operable vent section showed significant peeling.

Failed paint is not limited to window frames. Similar failures may occur on metal panels, guardrails, flashings, or canopies. Similar paint adhesion standards may be applicable as noted in the construction documents.



*Figure 7: Inside of the jamb extrusion on an operable vent frame. This paint flaked off with a fingernail.*

## RDH's Role

As outlined in our construction documents, all building components are required to meet an appropriate performance standard (AAMA 2604 in this case). Through the use of these standards and a diligent field review process, future problems are identified and rectified during the construction phase when they are relatively easy to correct.

For additional information on this and other topics, please visit our website, [rdh.com](http://rdh.com), or contact us at [contact@rdh.com](mailto:contact@rdh.com).