Construction Safety Association of Ontario

21 Voyager Court South, Etobicoke, Ontario, Canada M9W 5M7

(416) 674-CSAO (2726) ▪ 1-800 781-CSAO(2726) ▪ Fax: (416) 674-8866

www.csao.org info@csao.org

Final Report
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Ergonomic & Hygiene Interventions To Improve Health & Safety Of Drywall Finishing Workers

Greg Smith
International Union Of Painters & Allied Trades, D.C. 46
416-630-9604

Peter Vi
Construction Safety Association of Ontario (CSAO)
416-679-4050
petervi@csao.org

Hugh Laird
Interior Systems Contractors Association Of Ontario
416-746-4722
hlaird@isca.ca

Dru Sahai
Construction Safety Association of Ontario (CSAO)
416-679-4049
drusa@csao.org

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1.0 Plain Language Summary

Almost every construction project involves installation of drywall for the purpose of building interior walls. Drywall finishing can be divided into three tasks: (1) taping, (2) applying compound, and (3) sanding. First, finishers conduct taping tasks. They combine the paper tape and joint compound into a bucket. Once the paper tapes are covered with wet compound, finishers are required to step up on a scaffold, ladder, or bench and attach the tape along the joint of two connecting pieces of drywall. Secondly, using a wide and flat tip trowel, finishers spread joint compound onto and along each side of the joint with brush like strokes. The trowel is then used to press a paper tape into the wet compound and smooth away excess material. This is done to cover the joints and to conceal imperfections. After applying the compound, workers sand the treated areas to make them as smooth as the rest of the wall surface. Because of the use of elevated equipment, and forceful repetitive motions, finishing drywall sheets on lower and upper halves of the walls and ceilings exposes workers to several ergonomic, hygiene, and safety related hazards.

Drywall finishing tasks and associated activities are among the most hazardous in terms of potential for musculoskeletal disorders and occupational disease. In Ontario, drywall-finishing workers are covered under the plaster and drywall subrate group. Reviewing the number of lost-time injuries (LTI), it was found that this group has a higher proportion of LTI relating to non-traumatic events than the average Ontario construction industry. The median total cost per LTI and median duration of time-off-work is also higher for plaster and drywall work than the average of Ontario construction.

Clearly from the high LTI rate, WSIB claim costs, and severity of injuries among plaster and drywall workers, there is a need for an effective health and safety intervention. Past studies have suggested that to improve health and safety of drywall installation tasks, the intervention should be directed at reducing the frequency of awkward trunk and shoulder postures, repetitive forceful exertion, and drywall dust exposure. Two solutions are proposed in this study:

1. Pneumatic drywall finishing machine – This machine allows the drywall finisher to automatically apply compound onto and along each side of the drywall taped joint without the use of trowel or butting knife. Because an air compressor is used to spray the compound, the need to repetitively apply the compound with the hand is eliminated. This work procedure will reduce exposure to awkward shoulder and back posture when working on ceiling and lower level of the drywall area. Furthermore, the need to use a ladder, bench, or rolling scaffold is also decreased, which can also reduce the risk of traumatic injuries such as slips and falls.

2. Mechanical drywall sanding machine – Currently, workers have to manually sand the compound using a handheld block or a long-handled pole with a piece of sandpaper on the end of a swivel plate. This work procedure creates a lot of dust and places stress on the back, arms, and wrist, as pressure has to be applied to the paper to create the friction

for sanding. Use of electric sanders would reduce dust exposure and the force required to perform the task.

To assess the feasibility of various alternative drywall-finishing systems, experimental research was conducted in a controlled setting at the Interior Finishing Systems Training Center (IFTC). On each experimental trial, participants were asked to perform a simulated drywall-finishing task using traditional manual methods and the various alternative intervention methods. For both of the sanding and compound coating experiments, all participants were exposed to the same work area. While the participants were performing the experimental tasks, videotapes of the participants' working postures were recorded. Muscular activities, and dust monitoring samples were also collected at the same time.

For the Apla-Tech pneumatic drywall finishing experiment, all participants were asked to apply joint compound on a 582 ft^2 room using the traditional method and the intervention system. Before the start of the experiment, all participants were allowed to have a one-day training session in the proper use of the pneumatic drywall finishing system. On average, using the traditional method (i.e. using a hawk and trowel) the participants finished with a total time period of 31.62 min to apply joint compound. Using the Apla-Tech pneumatic drywall system, the participants finished with an average total time of 11.05 min - a decrease of 65% in comparison to the traditional method. When contrasting the muscular effort to apply joint compound onto walls, the Apla-Tech pneumatic system required significantly higher peak muscular effort. The higher muscular effort was mainly due to the higher tool weight (15 lb for the Apla-Tech versus 5 lb for the traditional method when both tools were filled with mixed drywall compound). Although the muscular effort is higher for the Apla-Tech system, the exposure level however, does not impose risk of musculoskeletal injuries. When comparing loads on the left forearm flexor muscles, the Apla-Tech system exposed the worker to significantly lower muscular exertion than the traditional method. Working on ladders, scaffolds and benches was reduced when working with the pneumatic tool, which can lead to a reduction in the risk of slip and fall related injuries. Based on these findings, it is concluded that the Apla-Tech pneumatic drywall finishing system has significant advantages for applying joint compound onto drywall.

Interventions to reduce/eliminate drywall dust exposure were also evaluated in this study. In construction, the sanding of drywall compound generates high levels of dust, including respirable silica. Inhaling this dust has been shown to cause eye, nose, throat, and respiratory tract irritation, coughing, phlegm production, and breathing difficulties. Worse, the presence of respirable silica in drywall dust raises the risk of silicosis, pulmonary tuberculosis, chronic obstructive pulmonary disease, and lung cancer. One method of controlling this occupational health hazard is the use of a shrouded ventilated rotary sander (SVRS). The effectiveness of an SVRS (Porter Cable Sander, Porter Cable Inc.) in collecting drywall dust was also evaluated in this study. This was done by comparing dust concentrations generated by traditional pole sanding with those generated by an SVRS. Eleven subjects participated in the study; two similar rooms coated with drywall compound were sanded; and personal aerosol monitors were used to measure respirable dust concentrations. Results indicate that the SVRS can reduce these concentrations by 96%. Silica was detected in the drywall compound used in this study at an average concentration of 5% making drywall dust control a continuing concern for drywall finishers. Muscular activities were also measured in this study to evaluate the forceful exertion of the upper limbs. Despite the

large differences in total weight between the SVRS (8 lbs) and the pole sanding tool (2 lbs), working with the SVRS significantly requires less muscular activity in the shoulder and forearm muscles. The high muscular effort in the manual pole sanding condition may be due to the forceful and repetitive movement of the upper extremity in order to create high friction force between the sanding paper and the wall. In the SVRS sanding condition however, little muscular effort is required because the majority of the sanding force was generated by the sanding machine. The muscular effort generated by the upper extremities while working with the SVRS was mainly used to support and glide the sanding machine along the walls. Based on the hygiene and ergonomic measures, it is concluded that the SVRS is an effective method for drywall sanding.

Additional studies are being proposed 1) to determine whether these interventions can be reproduced in a field setting, and 2) to assess the extent to which finishers are exposed to respirable crystalline silica during drywall sanding.