

# Evaluation of Three PPE Solutions on Welding Productivity at a Large Defense Contractor

## Background

A study was conducted with a large ship manufacturer that has asked to remain anonymous. However, they have agreed to have the study results published to share best practices and learnings.

This is a manufacturer of heavy, large-scale commercial and military vessels, most of which have been ordered by the United States Navy and are some of the world's most advanced ships. The company employs several thousand employees and several hundred welders.

With this type of complex work comes multifaceted health and safety challenges such as eye injuries and respiratory exposure to weld fume. Historically they utilized passive welding helmets, a grinding shield, elastomeric half-facepiece respirators, protective eyewear and hearing protection to meet OSHA requirements for the respiratory, head, eye, and face hazards seen by their welders.

However, the company wanted to evaluate other options. Accordingly, the key objective of this study as defined by the company's health and safety leadership team was to find innovative solutions to improve efficiencies, while also increasing worker safety and comfort, and continuing to meet OSHA requirements. As a result, the company obtained\* integrated welding/respiratory equipment from two manufacturers\*\* to evaluate whether such systems could result in productivity gains as well as to obtain worker feedback regarding comfort and other benefits they would anecdotally report.

## Study Methodology

Three different solutions were tested over a 7-week period. The study included a total of 10 welders from five different areas within the shipyard, both day and night shifts, as well as new and seasoned welders.

### Solution Descriptions:

1. 3M™ Adflo™ PAPR with 3M™ Speedglas™ 9100FX-Air Welding Helmet. The welding helmet had bump cap protection, an auto darkening filter (ADF) with Xxi Natural Color technology and integrated grinding shield. The helmet connects to a breathing tube to deliver clean filtered-air from the PAPR system.
2. Competitor PAPR system\* - The welding helmet had bump cap protection, an auto darkening filter (ADF), integrated grinding shield. The helmet connects to a breathing tube to deliver clean filtered-air from the PAPR system.
3. Control Solution – (Non PAPR) Passive welding helmet worn with a reusable half-facepiece respirator and separate grinding shield.

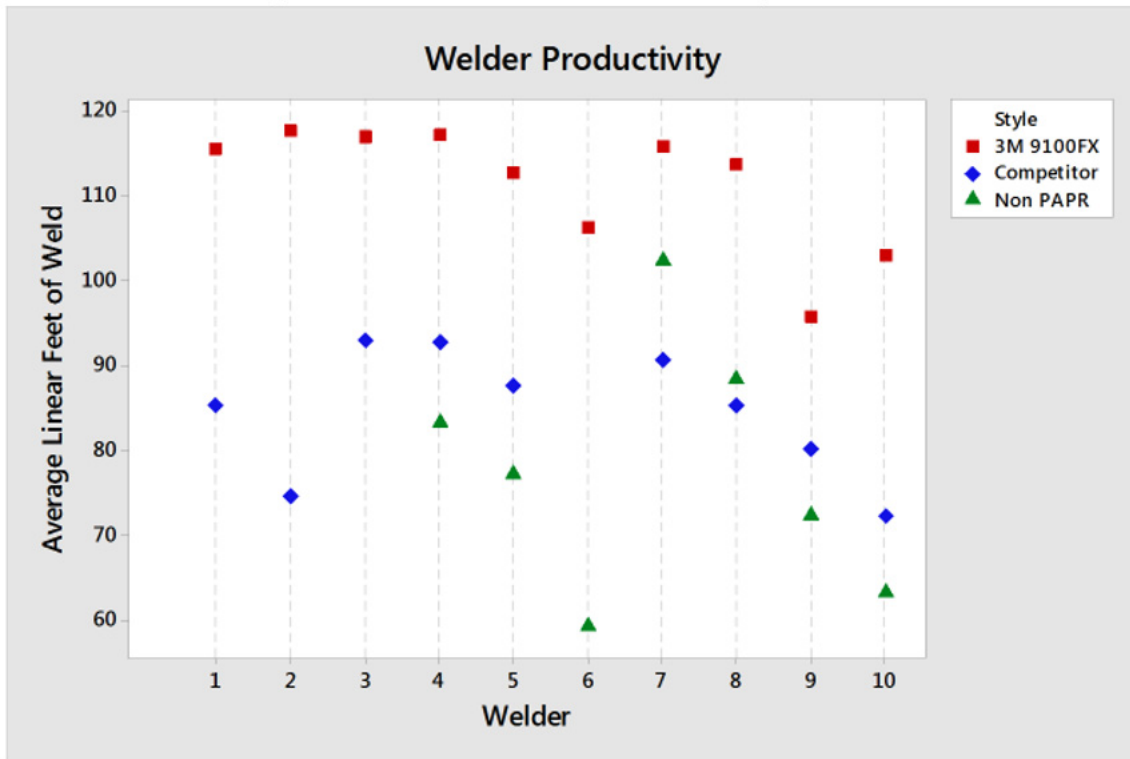
The study began by determining a productivity baseline while using the welders current PPE selection (Control Solution). A baseline of linear feet of weld was determined for 7 of the 10 welders. Subsequently, the remaining solutions were trialed across the 10 welders. Four welders tested 2 of the 3 solutions being evaluated. The remaining six welders tested all 3 solutions. Each week during the trial, the 10 welders' total linear feet of weld output was marked and tracked for that week.

**Table A.** Welder Demographics

Welder	Experience Level (years)	Work Area	Shift
1	16-20	Shell Shop (Flat)	Day Shift
2	16-20	Shell Shop (Flat)	Day Shift
3	10-15	Main Structural (Inverted)	Day Shift
4	10-15	Right Side Up (Overhead)	Night Shift
5	10-15	Main Structural (Inverted)	Night Shift

Welder	Experience Level (years)	Work Area	Shift
6	Less than 5	Main Assembly (Flat)	Day Shift
7	10-15	Erection Welding (Outside)	Day Shift
8	16-20	Shell Shop (Flat)	Day Shift
9	10-15	Main Assembly (Flat)	Day Shift
10	Less than 5	Main Assembly (Flat)	Night Shift

Table A describes the demographics of the 10 welders who participated in this study.



**Figure 1.** Welder Measured Production Output

## Results

Figure 1 shows a plot of the overall averages for each product solution by welder. For every welder in the study, the average productivity while wearing 9100FX was higher than the other styles tested. On average, the productivity while wearing 9100FX was 44% higher than while wearing the non PAPR equipment (individual welders ranged from 13%-80% higher productivity).

Although the results from this 7-week study are not statistically significant, they do suggest welding productivity was improved when welders wore the 9100FX. Additionally, for welders in the study who had a week using a non PAPR system and passive welding lens (Control Solution), productivity was higher when using a PAPR system with an ADF. A follow up study with all welders using every system, equal replication of systems, and randomization of systems could be done in the future to verify the results statistically.

Feedback from the company suggested that productivity gains, particularly for the 3M 9100 FX, were strongly tied to two key features:

- The superintendent of welding shared that he felt the 3M solution, which features the XXi Auto Darkening Filter, “was much clearer and had better color clarity and contrast compared to the competitor ADF and the current passive lens in the Control Solution.” This was reported to have shortened the time between set-up to welding considerably, and it appeared to improve the weld quality, reducing the amount of rework needed.
- Additionally, the participants reported that they found the PAPR systems were more comfortable than the reusable half-face respirator, which allowed the welders to stay under the weld hood longer, taking less break time. The integrated nature of the 3M 9100FX system and competitor system (i.e., integrated weld lens, grind shield and respirator) was reported to have helped save time on donning equipment, repeated adjusting and fitting. The weld superintendent also shared, “Although both 3M and the competitor are similar in features, the welders indicated additional ease of use and comfort in the 9100FX compared to the competitor tested.” He believed this caused the difference in performance and worker productivity seen in the study.

Benefits related to worker health and safety from use of integrated PAPR systems for welding were also noted anecdotally during the study, namely reduced breathing resistance, fogging and the potential for eye injuries. The PAPR systems provided a higher assigned protection factor (APF) for the welders, compared to the control solution, while providing a consistent airflow across their face which workers reportedly found not only refreshing, but also significantly reduced fogging of safety glasses. The 3M XXi ADF in particular was also reported to have improved situational awareness for the workers, while the ergonomics and lighter wearing helmet suspension was reported to help reduce welder fatigue when using the 9100FX, compared to the competitor’s solution. Lastly, the integrated grind shield was believed to reduce the potential for eye injuries by not having to transition between a standalone welding helmet to a standalone grind shield, limiting the exposure to flying debris and foreign objects.

## Discussion

This study was key to building the business case for adopting the 3M 9100FX solution across this shipbuilder’s production welding areas. The investment for such an undertaking is significant, in addition to the training and change management that must take place. Being able to document productivity gains over time within their own facility created the buy-in, and pay-back ROI needed from management, as well as the employees, to move forward.

Lastly, the welders indicated that the investment in the 3M 9100FX solution increased their morale and demonstrated the company’s commitment to their health and safety. Although such comments were anecdotal from the small group of employees included in this study, for this organization improving the safety culture was another key benefit from using the 3M 9100 FX product. This factor, along with the fact that the 3M welding solution demonstrated that it could help ensure the long-term financial stewardship of company resources, made a compelling case for conversion to the 3M welding solution provided.

\*3M provided some of the 3M product for the study.

\*\*The shipbuilding company in this study requested that the competitive product not be identified out of respect for the solution that was not selected.

3M provided analysis of the data.

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