

Welding 100— Welding Performance Indicators

Practical applications
and benefits



Airgas
an Air Liquide company

The Welding 100 – Welding Performance Indicators report from Airgas, an Air Liquide company, provides a benchmark for welding efficiency in the United States. It focuses on 100 welding operations spanning multiple industries, from large industrial companies to smaller custom fabrication shops, using baseline data collected during a span of 20 years from more than 3,000 welding, fabricating, and manufacturing locations. The end result is a valuable resource that identifies changes in efficiency while providing guidance for companies interested in improving the quality and efficiency of their operations.



A proven formula makes manufacturers more competitive by driving sustainable quality improvements, while simultaneously increasing productivity and lowering costs.”

–Bill Pharmer | Senior Director of Advanced Fabrication | Airgas

Welding Performance Indicators

For nearly 20 years, the Advanced Fabrication team at Airgas has worked to help customers better understand and improve the efficiency and competitiveness of their welding operations through the Unlocking the Hidden Cost of Welding™ program.

The process begins with a Welding Efficiency Analysis™ (WEA) in which Weld Process Specialists from Airgas collect and analyze key welding inputs. These inputs are used to help an organization identify wasted resources and determine how well their welding operation is performing. This first step is followed by a continuous improvement plan and, once complete, a Digital Welding Efficiency Analysis™ (DWEA™), to ensure an organization stays on track. Figure 1 presents an example of a DWEA dashboard.

Although our specialists look at numerous inputs, there are five key data points used to gauge the efficiency of an organization performing gas metal arc welding (GMAW). Those are:

1. Gas-to-Wire Ratio
2. Wire-to-Tip Ratio
3. Wire-to-Grinding Ratio
4. Wire-to-Liner Ratio
5. Operator Factor

These five metrics, or Welding Performance Indicators (WPIs), form the basis of the Welding 100 – Welding Performance Indicators report. It is called the Welding 100 because this report measures the performance of 100 customer locations of varying sizes across multiple industries, from large industrial organizations to smaller custom fabrication shops.

By identifying changes in efficiency across various industries within metal fabrication, we are able to provide a benchmark organizations can use to measure their own performance. For leaders and managers, this is a first step toward identifying shortfalls. Organizations can then engage a specially trained Weld Process Specialist from Airgas. This specialist can make specific recommendations for improvement and develop processes and procedures that help organizations produce better products more efficiently and cost effectively.



Figure 1: A MIG Welding Efficiency Dashboard, provided to customers who participate in a patented DWEA from Airgas, provides a snapshot of an organization's overall welding performance.

WPI 1: Gas-to-Wire Ratio

The first key metric measured and analyzed by Weld Process Specialists from Airgas is the gas-to-wire ratio. This ratio measures the volume of gas used during GMAW against the amount of wire fed through a welding system. This ratio is important as it significantly impacts weld quality. However, there are two other good reasons for focusing on this ratio. One, it can alert a welder to a leak in their gas line and two, this ratio can indicate whether gas flow is higher than specified. From a business perspective, a ratio that is too low can lead to poor quality work, while a ratio that is too high can lead to higher costs from purchasing more gas than necessary. This is why it is so important to get this ratio right.

Unfortunately, data collected over the past twenty years tells us many companies are not getting this ratio right. In fact, our data shows this number has steadily increased throughout the years. We believe this upward trend is caused by a combination of factors including improvements in the accuracy of data collected, turnover among welders, and the use of more bulk gas instead of cylinders.

Despite this increase, it is important to note that the increase is much smaller among customers working with a Weld Process Specialist at Airgas. On average, that number has increased an average of 37 percent among customers working with a specialist and up to 150 percent among customers not working with Airgas.

Among our Welding 100, the average gas-to-wire ratio is 16.25 cubic feet of gas for each pound of wire with the top performing locations achieving a ratio of closer to 6 cubic feet of gas per pound. In practice though, that ratio is incredibly difficult to achieve in a real world manufacturing environment. Figure 2 shows a customer with a gas-to-wire ratio of 15.4, slightly better than the Welding 100 average. This means this customer is using 15.4 cubic feet of gas for each pound of wire. It's not a terrible ratio but not great either and provides a starting point this customer can use to set performance goals.

Organizations who successfully lower their ratio will produce products with better quality welds while at the same time saving money on gas, but truthfully, the real cost savings come from an improvement in efficiency. Organizations will spend less time reworking bad welds and less time managing and changing out cylinders. As labor rates steadily increase and skilled welders become harder to find and retain, any increase in efficiency has the potential to significantly lower operating costs. In fact, organizations may be able to reduce operating costs by 20 to 40 percent.

There is also a potential improvement in efficiency and cost savings for customers who primarily use standard cylinders. By switching to newer, more efficient cylinder options like those found on our ARCAL™ gas cylinders with EXELTOP™ and SMARTOP™, customers can replace cylinders more quickly and reduce gas loss by 30 percent versus traditional cylinders. Also, the lower moisture content found in gases packaged in cylinders with advanced cylinder valve technology results in fewer welding imperfections, so not only do customers save time switching out cylinders, they also spend less time reworking bad welds.

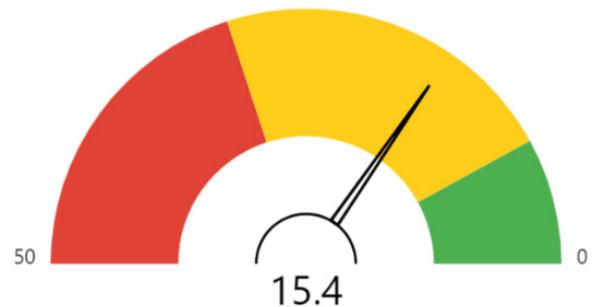


Figure 2: The gas-to-wire ratio is one of most widely used metrics. This example shows a customer who is using 15.4 cubic feet of gas for each pound of wire.



Innovative Cylinder Valve Technology

Exclusively from Airgas, ARCAL™ premium shielding gases with EXELTOP™ and SMARTOP™ cylinder valve technology are designed to improve welding performance, quality and safety. In addition, ARCAL cylinders reduce gas loss.

30% Reduction in gas loss compared to traditional industrial cylinders

WPI 2: Wire-to-Tip Ratio

The second ratio we focus on for our WPI is the wire-to-tip ratio. This ratio measures how much wire is going through a tip before replacement is needed (see Table 1). A number of different factors can impact this ratio. This includes weld material, wire type and outside factors like the type of grounding used for an electrical system. It is also impacted by an organization’s rules for when tip replacement is required or a welder’s own judgment.

Table 1: Sample Wire-to-Tip Ratio	
Pounds of Wire	40,000
Tips	4,000
Wire-to-Tip Ratio	10

On average, welders are getting 11.6 percent less wire through a tip than they were in previous years. Similarly, as we saw with the gas-to-wire ratio, this number can be dramatically improved by working with a Weld Process Specialist.

When the gas- to-wire ratio is too high, it doesn’t just cause an organization to use too many tips. The real issue is the amount of time spent changing out those tips. Even though it normally takes no more than 5 minutes to change a tip, we have found that in practice, very few tips are changed that quickly.

That’s because a welder must first stop what they are doing, remove at least some of their PPE, walk over to wherever tips are kept, find and grab the tip they need, and then walk back to their machine. We have watched welders do this and it’s not unusual for this entire process to take 10 minutes. That’s 10 minutes of downtime for one tip. Hourly rates among welders can vary, depending on geographic location and experience, but regardless, any increase in efficiency has the potential to significantly lower operating costs, including labor costs.

If an organization could improve its efficiency and, for the sake of this example, use 250 fewer tips per quarter, it could gain at least 41 hours of time per quarter. Over the course of a year, that’s nearly 167 hours (see Table 2).

Table 2: Yearly Savings from Optimized Ratio		
	Old	New
Number of Tips	4,000	3,000
Wire-to-Tip Ratio	10	13
Hours Saved	–	166.67
Labor Savings (\$27/hour)	–	\$4,500

*Assumes 10 minutes per tip change

WPI 3: Wire-to-Grinding Ratio

Our third WPI is the wire-to-grinding ratio. This ratio looks at the amount of welding wire used compared to grinding wheels or discs. Like the first two metrics, this metric has increased over the past 20 years as organizations switch from traditional grinding wheels to disposable discs which, as the name suggests, are not designed to last as long. The average ratio for the 100 locations illustrated in our report is nearly 8 pounds of wire per disc, an extremely low ratio when compared to best-in-class organizations who can often achieve a wire-to-grinding ratio close to 250. Organizations working with an Airgas specialist tend to experience consistent improvements in their wire-to-grinding ratio, similar to the results shown in Figure 3. The large differential indicates that organizations can gain efficiencies by working with a Weld Process Specialist to lower the amount of time spent grinding.

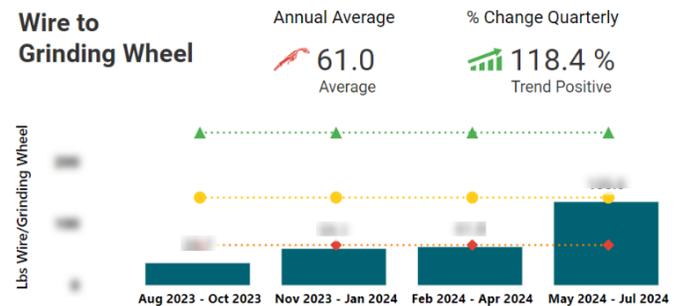


Figure 3: This customer's wire-to-grinding wheel ratio has steadily improved during a 12-month period, bringing their average ratio to 61 pounds of wire for each grinding wheel.

WPI 4: Wire-to-Liner Ratio

Our fourth metric is the wire-to-liner ratio. This ratio measures the amount of wire fed through the liner, the part of a MIG torch that guides the wire from the wire feeder to the contact tip, before the liner is replaced. Best-in-class organizations tend to replace liners more frequently as a worn liner can cause improper wire feeding which in turn leads to poor weld quality, increased downtime and expensive rework.

A very good wire-to-liner ratio is 500 pounds of wire per liner. Among the 100 companies tracked in this report, the average wire-to-liner ratio is close to 400 pounds. As we saw with our previous ratios, organizations like the one shown in Figure 4 who work with an Airgas specialist tend to experience dramatic improvements in this metric.

The good news for the industry as a whole is that this metric has shown steady improvement over the years. This improvement indicates that organizations have become better at establishing and following a maintenance schedule that includes regular replacement of the liner.



Figure 4: This customer has managed to improve their wire-to-liner ratio during the past 12 months by establishing a regular schedule that calls for changing out their liners more frequently.

WPI 5: Operator Factor

Our final WPI is Operator Factor (OF). This metric measures the amount of time a welder is actively welding. It is measured as a percentage by dividing arc-on time by total hours worked. A welder who welds for nine minutes out of an hour, a surprisingly typical amount of arc-on time in many organizations, would have an OF of 15 percent (9 minutes divided by 60 minutes.) This metric is a very telling data point as it is impacted by all other metrics in this report. After all, time spent changing tips or grinding is time in which a welder is not actively welding.

Among our Welding 100, the average OF is 8.87 percent, with best-in-class organizations achieving an OF of 28.17 percent. Still, even with an OF of more than 28 percent, the arc-on time is less than 17 minutes an hour.

Table 3 provides an example of how even just a small increase can impact welding performance. This example is for a facility with 20 full-time welders working a combined total of 40,000 hours a year. If this facility posted an OF of 15 percent, its welders would have spent 6,000 hours actually welding. If that same facility was able to increase its arc-on time by just 30 seconds an hour to 15.8% they would gain an additional 320 hours of arc-on time a year.

	Old	New
Operator Hours	40,000	40,000
Operator Factor	15%	15.8%
Arc Hours	6,000	6,320

Conclusion

A better understanding of key Welding Performance Indicators can help any organization improve the quality and efficiency of their operations. By identifying and reducing, if not eliminating, wasted time and resources, organizations can produce better quality welds and ultimately a better finished product. In addition, organizations will discover an ability to produce more product in the same amount of time, while simultaneously lowering their cost of doing business. Money spent on welding gases and welding consumables such as wire, tips, and grinding disks will decrease. Welder well-being and productivity will increase as welders are able to do what they do best.

Organizations interested in benchmarking their operations to the organizations in our Welding 100 can contact the Advanced Fabrication Team at Airgas. Our specially trained Weld Process Specialists can work with you to develop and implement a plan for quality assurance that generates sustainable savings for your business. Backed by more than 20 years of research and experience working with organizations of all types and sizes, a Weld Process Specialist from Airgas is well positioned to help you achieve operational excellence and ensure your performance is among the very best.

Fill Your Potential.™

Want to learn more?

Contact us!

800-909-8058

advancedfab@airgas.com

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