

## In-field Measurement of Mn:C Ratios for Steel Embrittlement with Z LIBS Handheld Analyzer

The steel industry has historically required Mn:C ratios to be 5 or higher in many carbon steels, for adequate toughness of the steel down to a temperature of -20F. During the past few decades, steel producers have gradually reduced the amount of Mn in the steel to reduce costs, while maintaining the Mn within the chemical specification. The result is a gradual reduction of the Mn:C ratio, despite the alloys being within the chemical spec, resulting in unexpected failures of some components.<sup>1</sup>

SciAps has introduced a handheld analyzer for carbon and other elements. The analyzer, Z-200C+, is the world's only handheld analyzer capable of measuring carbon content down to 0.015%, suitable to distinguish L-grade stainless from straight and H-grades, and to analyze most carbon steels. The Z also measures other alloying elements including Mn, Si, Cr, V, Cu, Ni, Se, Nb, Mo, Pb and others. Therefore the Z-200C+ also offers a handheld solution for fast, accurate determination of Mn:C ratios. The Z eliminates the need for laboratory results or cumbersome spark OES technology. It provides a fast, reliable result for C and Mn:C ratio within seconds, without having to transport bulky analyzers, massive argon tanks, or wait for laboratory analysis. The Z also provides carbon equivalent (CE) values using a variety of different formulas, depending on the user's choice.

Test	C	+/-	Mn	+/-	Mn:C	+/-
1	0.137	0.017	0.772	0.057	5.6	0.34
2	0.132	0.014	0.778	0.046	5.9	0.29
3	0.126	0.016	0.791	0.059	6.3	0.39
4	0.142	0.016	0.751	0.051	5.3	0.28
5	0.130	0.025	0.793	0.036	6.1	0.27
6	0.134	0.028	0.757	0.063	5.7	0.39

GROUP 1

GROUP 2

GROUP 3

AVG  
5.9

AVG  
5.8

AVG  
5.9

Table 1: Mn:C ratios from an A106 Carbon Steel

Sample data is shown in Table 1 for repeat, 3 second tests on an A106 carbon steel. The carbon, at an average concentration of 0.13%, is measured with good repeatability to a one-sigma precision of 0.006% absolute, as is the Mn. Mn:C ratios are calculated and displayed on the analyzer along with the chemistry. At a Mn:C ratio in the 5-6 range, the ratio is measured with a precision of about 0.3% for a single test. Averaging 3 tests (9 sec total test time) improves the precision to +/- 0.1%. Therefore, using the steel industry's recommendation of a minimum Mn:C ratio of 5, then any steel with a Mn:C ratio above 5.1 or below 4.9 can quickly be determined to have suitable (or not) Mn:C ratio.



### How Does it Work?

The Z-200 C+ utilizes LIBS (laser induced breakdown spectroscopy). We've replaced the bulky, power-hungry electric spark source in OES with a miniature, military-grade, high energy pulsed laser. The laser's small beam profile reduces argon consumption by a factor of 1,000. Now the argon supply is a small user-replaceable canister in the handle of the analyzer, instead of a large external tank. For general alloy analysis the argon yields about 600 tests. For L-grades, the number of tests drops to about 125 because several tests are averaged. Miniature laser, reduced argon volume combine to yield the world's ONLY handheld for carbon in stainless, steels, and other alloy materials.

### Summary

The Z is incredibly portable and fast. For your materials analysis jobs on pipelines, in racks, towers, you now have a handheld analyzer that's easy to carry in a front mount holster. Carbon content and full alloy chemistry in steels and cast irons can be analyzed in as little as 3 seconds. SciAps recommends averaging 3 tests for carbon steels (9 sec total) and 3-5 tests for L-grade stainless (9-15 s). The analyzer may be setup for fully automated analysis including bad burn rejection, or the operator has complete decision making control as to how many tests to use or reject to achieve a final result. Imagine the productivity increase you'll achieve not having to transport a large mobile OES system any more, and those large high pressure argon tanks.

<sup>1</sup> Sperko, Walter, NCPWB Technical Bulletin, May 2016.

### Need BOTH Carbon and the speed and ease of use of X-ray?

Meet the One-box. It combines both the X and the Z. The devices share accessories such as batteries, charger and cables. Both run the same intuitive Android Apps-based software making user cross training easy.

LIBS + XRF

### ONE BOX



### Don't Need Carbon?

Then check out our ultra-fast, precise X series handheld X-ray gun. The X provides alloy grade and precise chemistry in 1 second. It's built on Android to defy obsolescence, and offers automated data exporting, seamless wireless/Bluetooth communications to other devices and blistering speed on elements and alloys that are slow with other X-ray guns. Those include aluminum alloys, plus low Si, low Mg, P and S.



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