

## **APPENDIX H**

### **CHEMICAL ANALYSIS OF STEEL SAMPLES FOR STEEL SPECIMENS**

## Introduction

The chemistry of the steel utilized in the SAC investigations should be determined and reported using the guidelines given below. The purpose of collecting the information on the chemistry of the steels is to compare the results with specification limits and to document the complete chemistry, including elements not specified in the product specification, of the steel for comparison with other steels used in the program. The chemistry of the steel affects the weldability, toughness, and strength of the steel. The chemistry will not be an exact match with the mill test due to differences in ladle or heat testing employed in the mill and the value found in your product analysis. The limits on the product analysis are larger than the limits on the heat analysis provided by the producer. The product analysis tolerances are given ASTM A6 Table B. If the product analysis chemistry differs from the chemistry reported by the mill by more than this tolerance, a re-test should be performed to confirm the results of the product analysis. If the re-test confirms the initial results, it is likely that mill test report does not correspond to your section, and further study is needed.

The analysis shall include the elements listed in the table below. The ladle chemical composition requirements of A572 Gr. 50 and the new specification for structural shapes just approved by ASTM, labeled AXXX, and are shown for reference.

<b>Element</b>	<b>A572 Gr. 50</b>	<b>AXXX</b>
Carbon	0.23 max	0.23 max.
Manganese	0.50-1.35 Mn to C ratio shall not be less than 2 to 1. Maximum Mn of 1.50% is permissible if the carbon maximum is reduced to 0.20%	0.50-1.50 <sup>A</sup>
Phosphorus	0.04 max.	0.035 max.
Sulfur	0.05 max.	0.045 max.
Silicon	0.40 max., min. of 0.15 for shape over 426 lb/ft	0.40 max.
Aluminum		Min. 0.015 or min Si of 0.10
Copper		0.60 max
Nickel		0.45 max.
Chromium		0.35 max.
Vanadium	Type 2: 0.01-0.15, Type 3: 0.02-0.15	0.11 <sup>B,C</sup>
Colombian / Niobium	Type 1: 0.005-0.05, Type 3: 0.05 max	0.05 max. <sup>C</sup>
Titanium		
Molybdenum		0.15 max.
Lead		
Tin		0.02 max.
Nitrogen	Type 4: 0.015 plus Vanadium with minimum ratio of Vanadium to Nitrogen of 4 to 1.	
Boron		

**Notes:**

- A. Provided manganese to sulfur ratio of not less than 20 to 1, the min. limit for Group 1 shall be 0.30
- B. The amount of columbium and vanadium shall not exceed 0.15%
- C. When vanadium is added as the only nitrogen-binding element, nitrogen shall be reported and the ratio of vanadium to nitrogen shall be 4 to 1 or higher if the nitrogen content is greater than 0.012%

The analysis of these elements is normally done using mass spectrometer. A small sample is all that is required. Many laboratories will add an extra cutting charge if too large a sample is sent. Discuss the sample size requirements with the laboratory before you send the sample. Also be sure that you give them the expected range of the elements so they can determine if their equipment has sufficient sensitivity and accuracy. The lighter elements may not be easily detected with older equipment. Special light element kits are available for some machines. The most accurate method is to use a Leco Combustion Analyzer particularly for nitrogen and low carbon levels.