

# CICIND

## Model Code for Steel Chimneys

**Revision 1 - 1999  
Amendment A – March 2002**

Copyright CICIND 1999  
ISBN 1-902998-09-X

**and**

**Commentaries and Appendices  
(December 2000)**

Copyright CICIND 2000  
ISBN 1-902998-11-1

### **DISCLAIMER**

CICIND documents are presented to the best of the knowledge of its members as guides only. CICIND is not, nor are any of its members, to be held responsible for any failure alleged or proved to be due to adherence to recommendations, or acceptance of information, published by the association in a Model Code or other publication or in any other way.

**Office of the Secretary:**  
Preussenstrasse 11  
40883 Ratingen  
Germany  
email: [secretary@icind.org](mailto:secretary@icind.org)  
[www:cicind.org](http://www.cicind.org)

## FOREWORD

When it was formed in 1973, the "Comite International Des Cheminees Industrielles" (CICIND) adopted as a major goal the harmonisation of national codes for the design of industrial chimneys. As a means to this end, a subcommittee was appointed in 1981, charged with drafting a proposal for a model code for steel chimneys which reflected the current "state-of-the-art" and a consensus of views, internationally. This document was published in 1988, with Commentaries being published the following year.

Since 1988, the science and technology of chimneys has advanced and in 1995, CICIND appointed a committee to revise the Model Code, recognising current best international practice and knowledge.

The committee comprises:

J. Roberts (Great Britain)  
B.N. Pritchard (Great Britain)  
Max Beaumont (Great Britain)  
Michael Beaumont (Great Britain)  
G. Berger (Germany)  
J. Bouten (The Netherlands)  
R. Ghermandi (Italy)  
S. Ole Hansen (Denmark)  
G. Pinfeld (Great Britain)  
H. van Koten (The Netherlands)  
R.M. Warren (U.S.A.)

Expert advice was received from:

B.J. Vickery (Canada)

## Table of Contents

	Foreword	
0	Introduction	
0.1	General	
0.2	Appendices and Commentaries	
0.3	Philosophy	
1	Scope	
2	Field of Application	
3	References	
4	Notations, Units and Definitions	
4.1	General	
4.2	Subscripts-Superscripts	
4.3	Units	
4.4	Definitions	
5	Basis of Design and Safety Factors	
5.1	General	
5.2	Reliability differentiation	
5.3	Partial Safety Factors	
5.4	Cross-wind effects	
6	Materials	
6.1	General	
6.2	Structural steels	
6.3	Stainless and alloy steels	
6.4	Expansion characteristics	
7	Actions(External and Internal)	
7.1	Permanent Load	
7.1.1	Dust load (temporary load)	
7.2	Wind	
7.2.1	General	
7.2.2	Wind Speed	
7.2.2.1	Basic wind speed	
7.2.2.2	Design wind speed	
7.2.2.3	The influence of topography	
7.2.3	Wind load in direction of the wind	
7.2.3.1	Wind load on isolated chimneys	
7.2.3.2	Mean hourly wind load	
7.2.3.3	Effect of fluctuating part of the wind-speed	
7.2.4	Vortex shedding	
7.2.4.1	General principles	
7.2.4.2	Estimation of top amplitudes	
7.2.5	Ovalling	
7.2.5.1	Static effects	
7.2.5.2	Dynamic effects	
7.2.6	The increase of wind effects by nearby structures	
7.2.6.1	Increase in along-wind load	
7.2.6.2	Increase in cross-wind response	
7.2.7	Damping ratio	
7.2.8	The first and second natural frequencies	
7.2.9	Passive dynamic control	
7.2.9.1	Aerodynamic stabilisers	
7.2.9.2	Dam, ping devices	
7.2.9.3	Special chimney designs for damping.	
7.3	Earthquake loading	
7.4	Thermal effects	
7.5	Explosions	
7.5.1	External explosions	
7.5.2	Internal explosions	
7.6	Internal effects governing the chimney design	
7.6.1	High temperature flue gases	
7.6.2	Fire	
7.6.3	Chemical effects	
8	Design of Structural Shell	
8.1	Minimum thickness	
8.2	Required checks	
8.3	Carrying capacity of shell	
8.3.1	Load factors and load combinations	
8.3.3	Biaxial stresses	
8.3.4	Stability	
8.4	Serviceability of shell	
8.5	Fatigue check	
8.5.1	Basic principles	
8.5.2	Fatigue strength	
8.5.3	Influence of high temperature	
8.6	Allowance for corrosion	
8.6.1	External corrosion allowance	
8.6.2	Internal corrosion allowance	
9	Design Details	
9.1	Connections	
9.1.1	General provisions	
9.1.2	Bolted connections	
9.1.2.1	Shear	
9.1.2.2	Bearing on connected surfaces	
9.1.2.3	Tension	
9.1.2.4	Combined loading	
9.1.2.5	Deduction for holes	

9.1.3	Welded connections
9.1.3.1	Full penetration welds
9.1.3.2	Fillet welds
9.1.3.3	Weld testing
9.2	Flanged connections
9.3	The support at the base
9.3.1	Anchor bolts
9.3.2	Grouting
9.3.3	Temperature effects
10	Steel liners
11	Construction
11.1	General
11.2	Structural shell
11.3	Structural flanges and opening reinforcement
11.4	Stiffening rings
11.5	Base plate
11.6	Straightness
11.7	Erection tolerance
12	Surface Protection
13	Openings
14	Guyed, Structure Supported and Stayed Chimneys
14.1	Structure supported and stayed chimneys
14.2	Guyed chimneys
15	Protection Against Lightning
16	Access Ladders
17	Aircraft Warning Lights

## 0. INTRODUCTION

### 0.1 General

Chimneys are required to carry vertically and discharge to the atmosphere, gaseous products of combustion, chemical waste gases, exhaust air or for the combustion (flaring off) of industrial waste gases.

This Model Code contains guide-lines which reflect the current state of art in the design and construction of steel chimneys. Nevertheless, the design, fabrication and erection of steel chimneys require a thorough knowledge of these structures, the properties of the materials used, the actions occurring upon the structure and the recognised rules of the relevant technologies. The design of steel chimneys should therefore only be entrusted to appropriately qualified and experienced engineers. The construction and erection should be carried out by firms competent in this class of work. At all times the work should be under the direction of appropriately qualified supervisors.

CICIND will continue to try to improve the understanding of the behaviour of chimneys. Further revisions of this model code will therefore be published from time to time.

## 0.2. Appendices and Commentaries

This Model Code is accompanied by extensive appendices and commentaries. The appendices provide information which the committee believes will be of use to a steel chimney designer, even though its inclusion in a chimney design code could not be justified. The commentaries have the following objectives:

- a) Justification of the regulations of the model code.
- b) Simplification of the use of the model code.
- c) Understanding of the meaning of the regulations of the model code.
- d) Documentation of the areas in the model code where the present knowledge is sparse so that the regulations are possibly or probably not optimal.

The following items are **not** objectives of the CICIND commentaries:

- e) Change of the meaning of certain regulations of the model code where these are falsely expressed or obviously wrong.
- f) Definition of the meaning of certain regulations of the model code which are so badly formulated that they could easily be misinterpreted even by experts.

Certain information from the model code is repeated in the commentaries when this simplifies the presentation of the ideas.

## 0.3 Philosophy

One of the main objectives of any code governing construction is the creation of a model which resembles as far as possible, the real situation. The model should be sufficiently "safe, simple and true". It is very rarely that simplicity and truth are compatible, so a model must be used which provides an optimum compromise between truth, simplicity, safety and economy.

While the judgements of 'sufficiently true' and 'sufficiently simple' are subjective, 'sufficiently safe' is capable of rational judgement. This code interprets 'sufficiently safe' in terms of the social and economic consequences of failure. It does this by comparing the probabilities of failure for given safety factors during its design life with the failure probabilities required to satisfy accepted social and economic criteria. This leads to the development of safety factors which ensure that a chimney will have a probability of failure during its design lifetime between  $10^{-3}$  and  $10^{-4}$ , depending upon its reliability category.

CICIND has departed from generally accepted principles of steelwork design and construction only when this was required by the philosophy outlined above or by specific chimney requirements.