



ICOLD EUROPEAN CLUB

**Working Group for Geomembranes and
Geosynthetics as Facing Materials**

FINAL REPORT

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SYNOPSIS. This ICOLD Bulletin is the new revised edition of former Bulletin 78 on watertight geomembranes for dams. The contents of the final drafts, as approved by ICOLD, are outlined.

INTRODUCTION

ICOLD Bulletin 78 – Watertight geomembranes for dams – State of the art, was published in 1991. In the 15 years elapsed after that date, geomembrane sealing systems have been found increasing application, also of unprecedented types. The European Working Group for Geomembranes and Geosynthetics as Facing Materials has been entrusted the preparation of a new revised and updated edition of the bulletin by ICOLD Committee on Materials for Fill Dams. The final draft of the new bulletin was submitted for discussion and approval to the Committee at the ICOLD Congress in Montreal, June 2003. The status at the date of preparation of this document is that the Committee has approved the draft in all its contents, only Chapter 4 being still under perusal.

CONTENTS OF THE NEW BULLETIN

The contents of the new bulletin are summarised here below.

Chapter 1 - Introduction

It identifies the scope and contents of the bulletin, and outlines the large family of geosynthetics, grouped according to their characteristics and field of application.

Chapter 2 - Materials, Testing, Ageing

The chapter presents composition (resin, plasticisers, UV absorber, anti-oxidants ect.) configuration (with or without reinforcement, type of reinforcement), manufacturing methods (calendering, extrusion, spreading) for polymeric geomembranes, and manufacturing and specific properties of bituminous geomembranes. All types of polymeric and bituminous geomembranes used in dam applications are analysed in respect to their

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seaming methods, and compared in respect to tensile properties, resistance to high and low temperatures, to freeze/thaw, ease of connections to structures, chemical resistance, durability, friction coefficient, method of joining, evaluation of seams, repairability.

The chapter addresses the various tests performed on geomembranes from their manufacturing

- Quality control testing during manufacture
- Identification /compliance testing
- Performance testing
- Compliance testing

describing the mechanical properties (elongation, puncture, impact, burst, tear, shear, etc) that should be tested as crucial to the service behaviour of the system, together with those related to chemical, biological, thermal, UV and ozone aggressions. More frequently adopted test methods for each property are listed, and special emphasis is given to multi-axial performance testing. Long-term performance of each type of geomembrane, obtained from the information collected by the database, is analysed.

Chapter 3 - Loads applied to geomembrane sealing systems (GSS)

The chapter analyses the loads transmitted to the geomembrane by the types of attack to which it can be subject during service, discusses the consequences that each load may have on the GSS, and the provisions and precautions that are taken to avoid damage. Mechanical attacks include those imparted by gravity, subgrade differential deformation, puncture, wind, waves, ice, uplift. Physical, chemical and biological attacks include temperature variations, UV, chemicals in water, microorganisms, vegetation, flora, fauna, and vandalism.

The chapter addresses those loads that are common to all types of dams. The loads and considerations that should be specific for fill dams, for concrete dams, and for RCC dams, are addressed in the chapters relevant to each type of dam.

Chapter 4 - Geomembranes for new construction and rehabilitation of fill dams

This chapter is still under perusal. The final draft submitted to the Committee illustrated all types of possible applications (upstream exposed or covered, central sub-vertical or zigzag), discussing for each configuration the type and stability of the various layers, the anchorage on the face and at boundaries, the installation techniques for rehabilitation and new construction. Typical examples of the most adopted configurations were presented.

Chapter 5 - Geomembranes on masonry and concrete dams

The organisation of the chapters dedicated to each type of dam is similar. It illustrates the range of applications in new construction and in rehabilitation, and gives design principles for partial applications, for exposed GSS, and for covered GSS. Properties of the geomembrane, subgrade and support layer, drainage, linear and surface anchorage, anchorage at boundaries, cover layer where applicable, are discussed.

The chapter addresses installation features in the dry and underwater, and outlines typical examples.

Chapter 6 - Geomembranes for Roller Compacted Concrete dams

The chapter illustrates the range of applications (new construction, rehabilitation), discusses the two systems available for new construction (exposed system and covered system), and the rehabilitation system that has been recently developed.

As for chapter 5, design principles, installation techniques, and typical examples, are presented.

Chapter 7 - Special cases

The chapter addresses cases in which the geomembrane system has been used for repair of limited areas, or in which the application has been performed in conditions very much different from usual.

Focus is on the repair of joints and cracks, as adopted in especially on Concrete Faced Rockfill Dams and RCC dams, and on the use of the GSS as external waterstop for RCC dams in new construction.

As for chapter 5, design principles, installation techniques, and typical examples, are presented.

Chapter 8 - Control of Quality of a Geomembrane Sealing System

The chapter defines the concepts of Manufacturing Quality Assurance, Manufacturing Quality Control, Construction Quality Assurance and Construction Quality Control.

The various items to be covered to assure a well performing GSS are addressed, including those aspects crucial to assure survival before and during installation.

Quality Control methods, frequency and acceptance criteria are illustrated.

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Chapter 9 - Guidance on technical content of contracts

The chapter discusses the types of possible approach to a tendering process, and points out what should be consider when evaluating the various aspects of the project.

The data that the owner must provide in the tender, the contents of Technical Specifications of the tender, in terms of materials properties, conditions and criteria of acceptance of surface, anchorage, seaming, perimeter seals, ballast layer, experience of the proposed material, experience of the proposed system, are outlined. Some examples of acceptance criteria are given. Warranty and Bill of Quantities are also discussed.

Appendixes

There are 3 appendixes: one for bibliographic references, one for geosynthetics terminology, and one for the database.

The database includes a great number of information collected through a Technical Form submitted to owners/engineers/designers. More than 230 dams are scrutinized.