STANDARDS AND CODES IN THE IRRIGATION INDUSTRY

A POSITION PAPER

March 1998

The Australian Irrigation Technology Centre

Thebarton SA 5031

National Program *for*
Irrigation Research and Development

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EXECUTIVE SUMMARY

Standards and codes are recognised by governments as an essential part of a nations trade infrastructure as important as physical assets like roads and airports. This paper summarises the current position in the Australian irrigation industry with regard to the adoption, use, development and monitoring of codes.

254 documents have been catalogued in a list of standards and codes applying to various aspects of the irrigation industry. They are classified according to the author and content. It can be concluded that these documents form a description of both practice and equipment quality that should be referenced in any manual of best practice in irrigation.

The existence of these documents indicates that any equipment sold into the irrigation industry could be tested according to an internationally recognised standard. The cost borne by the industry for equipment failure or from poor engineering practice is avoidable.

It is suggested that standards use is not widespread because of the following factors;

- It can be difficult to discover whether a standard exists for a particular issue
- The technical jargon used to write the standard can be hard to understand
- Standards are often written for “ideal” situations and tests of equipment under these conditions may be of limited relevance to a “real world” situation.
- Strict copyright laws can restrict access.

A 1995 Commonwealth Committee of Inquiry into “Australia’s Standards and Conformance Infrastructure” identified seven key issues to be resolved. These were:

1. Measurement Issues
2. Standards Writing Issues
3. Regulatory Standards and Conformance Issues
4. Conformance issues relating to National Association of Testing Authorities (NATA) and the Joint Association for Standards of Australia and New Zealand (JAS-ANZ)
5. Quality Management Systems Certification
6. Marks
7. Issues Relating to Coordination and Strategic Direction

Each of these issues is important but the issue of measurement standards in relation to water as a commodity has particular implications for the industry. The recommended procedures require a higher level of accuracy and rigour than that which is commonly found in the industry.

It is proposed that the existing members of the Australian Irrigation Council, particularly the IAA and ANCID collaborate in managing standards and codes within the irrigation industry. It is important that any system, built on the existing IAA committee structure be open and responsive to industry needs.

1. INTRODUCTION

This report has been prepared in response to a request from the Land and Water Resources Research and Development Corporation (LWRRDC) to the Australian Irrigation Technology Centre (AITC) to prepare a paper detailing the current status of standards and codes as they relate to the irrigation industry in Australia. In addition to listing the existing standards and codes the report was to:

"address the question of implementing and monitoring published and existing standards and codes."

The first part of this report deals with existing standards and codes, in particular it details the scope, number, author and location of the standards.

The second part of the report discusses the issues and questions to be resolved if existing standards are to more widely adopted and if new standards of relevance to the irrigation industry are to be developed. This section of the report has relied on the recommendations of a Committee of Inquiry (Kean Inquiry) into Australia's Standards and Conformance Infrastructure and the response of the Federal Government to this report. The proposed arrangements for the distribution and development of codes in the irrigation industry has followed the principles set out in the Government response to the Kean Inquiry. This has been done to ensure that the standards and conformance infrastructure for the irrigation industry is consistent with the national approach.

2 STANDARDS AND THEIR ROLE IN THE AUSTRALIAN ECONOMY

Standards Australia in the introduction to their annual report provide definitions of standards and their value to the economy.

"The dictionary defines a Standard as; "*An accepted or approved example against which other things may be judged or measured."* Single reference points have been used by many societies for centuries, particularly in relation to weights and measures for food and agriculture. Now, after the industrial and technological revolution of the past two hundred years, a more focussed definition is used: "*A Standard is a published document which sets out technical specifications or other criteria necessary to ensure that a material or method will consistently do the job it is intended to do."*

The report goes on to describe the many different situations in which standards and codes are used and it also describes the fundamental way in which standards influence everyday life. Measurement of goods like electricity, petrol, and food is accepted by society as necessary for fair trade to exist. The closer trading links between Australia and its trading partners have also heightened the need for standards. An acceptable level of trade will not occur unless both trading partners are confident that goods and services supplied by the other partner meet certain standards. This principle applies whether the trade is local between a consumer and a tradesperson or international between multinational corporations The Council of Australian Governments (COAG) in its review of Standards and Conformance Infrastructure emphasised that standards and codes are an integral and essential element of an economy's infrastructure in the same way as physical infrastructure such as roads and airports.

2.1 Standards in the Australian Irrigation Industry.

Chapter 3 of this report details the number and range of existing Australian and International standards and codes that relate specifically to irrigation. In spite of the large number of products and practices that are covered these standards and codes are not widely used or referred to by the irrigation industry in Australia. This is in spite of the COAG view that standards are a fundamental part of economic infrastructure.

There are published standards and codes that cover every aspect of irrigation from extracting water from a source to drainage from irrigated fields and covering all intermediate phases of irrigation such as design , installation and operation of systems. The documents also cover the engineering practices to be used, the skills required of the people undertaking the works and the materials to be used in the works. More widespread adoption of standards and codes could benefit the Australian irrigation industry through improved standards of design, installation and operation of systems. For example irrigator dissatisfaction with product performance or system design and installation could be reduced if they had greater knowledge of existing standards and were able to use them to prepare more exacting specifications.

An example of the potential impact of a standard is provided by the development and adoption by manufacturers of the Australian Standard for low density polypipe.

Polypipe was used extensively in the development of stock watering systems as well as in the development of irrigation systems. As a product it is relatively inexpensive to manufacture, as a result large manufacturing companies receive strong competition from smaller manufacturers. Some manufacturers controlled costs in this price competitive market

by reducing quality control measures, such as buying cheaper substrate. As a result there were a large number of in-field failures of product. A committee was formed under the auspices of Standards Australia and a standard was written and adopted by the manufacturing industry. The AS number is now stamped on each role of polypipe that complies with the standard. This enables each manufacturer whose product complies with the standard to differentiate the product in the marketplace. Field failures have reduced in number significantly and prudent buyers never purchase polypipe unless it is stamped with the Australian Standard number.

The situation is voluntary and so not all poor quality product is banished from the market, but at the least a marketing mechanism exists which does add value to the better quality product.

A major issue facing the irrigation industry leaders is how to encourage and facilitate greater adoption of those standards and codes which have the potential to benefit irrigators, water resource managers and other participants in the industry.

3. EXISTING CODES

Table 1 indicates the number of standards and other documents, in a range of categories, that have been located in a search carried out by the AITC for the Murray Darling Basin Commission. Standards and documents relating to more than one category have been counted in each relevant category. The complete list of documents is contained in Appendix 1 with ISBN included where applicable.

Table 1. Existing irrigation codes and standards

Category	*International Standards*	*Australian Standards*	*ASAE Standards*	*Other Documents*
Water supply and storage	-	-	1	5
Pumps	-	3	2 (draft)	2
Filters	3	-	1	-
Irrigation and drainage pipes and fittings				
-General	1	10	2	-
-uPVC	1	24	1 (draft)	-
-PE	6	13	1 (draft)	-
-ABS	-	4	-	-
-GRP	-	13	-	-
-Concrete	1	1	1	-
-Metal	1	3	1	1
Valves and regulators	10	8	1 +1 (draft)	-
Sprinklers, sprayers and emitters	6	-	2 +3 (draft)	6
Surface irrigation	-	-	2	4
Travelling irrigators	3	-	3	-
Water quality	-	-	1	2
Water management	-	-	-	2
Design, installation and maintenance	-	2	10 +3 (draft)	17
Earthworks and drainage	-	1	6 +8 (draft)	7
Meters, measurement and automation	6	1	1 (draft)	-
Training	-	1	-	-
Electrical installations	1	8	3	-
Plumbing and construction	-	7	-	-
Health and safety	-	1	3	-
General	-	-	1	14

ASAE = American Society of Agricultural Engineers

The list has been arranged in categories to show the existence of codes and standards for each industry stage or major component. It follows the flow of water from a supply point through an irrigation system to drainage and then indicates other documents of a more general nature which apply across all stages of irrigation. It includes relevant codes for related trades such as plumbing and electrical which should be used in some stages of installation of an irrigation system. The purpose of this is to allow managers and others with an interest in standards and codes to identify existing technical guidelines for their specific field of interest.

It is proposed that a complete list of all the above documents (including abstract) will be published on a World Wide Web page on a future home page for the Australian Irrigation Technology Centre. This will facilitate easy and wide distribution of the list enabling interested parties to determine which documents are relevant to their situation and also allow feedback on any omissions.

It is important to note that the list has been assembled from a world wide search and it is unlikely that many organisations or individuals in the Australian irrigation industry would have knowledge of the majority of these documents. The publication status of these documents varies considerably. Some are public documents available from organisations such as Standards Australia for a small fee while others are draft copies of documents prepared for a specific geographical region. Not all documents are available to irrigators. However they have been listed because it indicates the work that has already been committed to the development of standards and codes, giving rise to the possibility that more published documents could be prepared relatively quickly.

All adopted International and Australian standards are available from Standards Australia, and standards and engineering practices of ASAE are available directly from the association. Contact details for these organisations are given in Appendix 2. Other documents with an ISBN listed may be available through libraries but the number of copies throughout Australia is likely to be quite small.

Standards Australia has a policy of adopting international standards wherever possible and this is highlighted by the absence of any Australian standards for sprinklers, emitters and travelling irrigators, which are covered by International standards. This approach is supported by the irrigation industry which is aware of the market benefits of developing products suitable for the international market, not just the limited Australian market.

The collection of standards cover the most common hardware items used in an irrigation system but there is a lack of guidelines indicating how these systems should be designed, operated and maintained in Australian conditions. Recent texts covering these topics for landscape, surface and microirrigation have been written in the USA but similar texts for Australian conditions have not been found.

4. AVAILABILITY, ADOPTION, USE AND MONITORING OF CODES

Standards are public documents and as such are reasonably accessible. However unless an industry is compelled by some form of regulation such documents are usually not widely read. In the irrigation industry where compliance with standards is voluntary few people are aware of existing standards or codes. There are a number of reasons for this.

- Some standards are hard to find. The documents cited in this report were identified from a search that included a number of different countries and the use of the internet. Such a search is not an option for an individual, unless there is a very compelling reason.
- Equipment standards are written in technical jargon which can make their purpose difficult to understand and their practical relevance to industry unclear.
- Some of the codes and standards are written in other countries and have limited relevance in Australia.
- Documents from Standards Australia range in price from $10 to over $150 depending on the standard and so price can be a deterrent to an individual who may only wish to access a standard once.
- Delay in receiving the material once appropriate documents have been identified. Unless one has access to a capital city library or to a Standards Australia office it can take some days and possible weeks to obtain some standards.

Of these issues the relevance of equipment standards is probably the biggest issue. Surveys of irrigators have shown that they are most interested in comparative data obtained from field trials as a basis for choosing between equipment. However an essential element of a standard which relates to equipment or materials is that it specifies standard conditions under which the product or material can be tested. This is important so that material or equipment tested in different locations is tested using the same test methodology. In the majority of cases this requires a well regulated laboratory type environment in which variables such as temperature, flow and pressure can be measured accurately, if not controlled completely. This can lead to some standards specifying very precise and accurate tests which may have little relevance to a real life situation. It is a common perception amongst irrigators that laboratory tests of equipment have little relevance.

In 1995 the Federal Government commissioned a Committee of Inquiry (the Kean Inquiry) into Australia's Standards and Conformance Infrastructure which was charged with "formulating recommendations to the Government to ensure that the infrastructure continued to meet Australia's needs in a rapidly changing world."

The Committee identified seven issues which impact on the adoption, monitoring and use of standards. These were:

1. Measurement Issues
2. Standards Writing Issues
3. Regulatory Standards and Conformance Issues
4. Conformance issues relating to National Association of Testing Authorities (NATA) and the Joint Association for Standards of Australia and New Zealand (JAS-ANZ)
5. Quality Management Systems Certification
6. Marks
7. Issues Relating to Coordination and Strategic Direction

The Government response to the issues raised by the Inquiry provides a basis for the irrigation industry to consider the use of standards and codes in its industry. All the issues identified are important but some of the recommendations have more immediate implications for irrigation. If implemented, the recommendations establish the policy framework within which all standards and codes in Australia will be written, maintained, their adoption monitored and which organisations have the responsibility and role to manage these activities. The rural water industry could use these principles to establish its own system of adopting and monitoring standards and codes.

The following sections discuss the seven issues identified by the Inquiry as they relate to the rural water and irrigation industry in Australia. The Inquiry covered a much wider range of issues but only those of direct relevance to water and irrigation are discussed.

4.1 **Measurement Issues**

The Inquiry identified that there was no common system of trade measurement in Australia, with responsibility shared between the Commonwealth and the States. It was recommended that a uniform national system be implemented under the jurisdiction of the Commonwealth. It was also noted that there was inadequate appreciation of the need for accurate measurement.

The key issue for irrigation relates to the recommendations relating to “utility meters”. The paper notes; “Confidence by consumers in meter accuracy is becoming increasingly important to water with the introduction of sale by volume”. The COAG reforms as they are implemented will reinforce the need for accurate measurement. In addition the creation of a national water market could imply that the same levels of accuracy will be required for measuring irrigation water as those required for measuring potable water supplies.

Legislation is currently being considered by the Federal Government which is expected to be introduced within the next six months. The legislation will empower commonwealth inspectors to visit water supply authorities and review the accuracy of their meters. It will be expected that the authorities will have implemented a quality control system which will give confidence to consumers that meter readings are accurate. The systems will involve a system of auditing, in which random samples of meters are tested by an independent authority for “measurement error”. At present the legislation will only apply to potable water supplies but it is a small step for a keen water conservationist to insist that irrigation water supplies are measured with the same accuracy, regardless of the water source.

The industry should appreciate that an accurate system of measurement is fundamental to a fair water trading scheme. Without accurate measurement of the commodity being traded there can be no fair trade.

A key role was identified for the National Measurement Laboratory (NML). The recommendations included;

- NML be declared as a National Facility within CSIRO and that it be charged with providing leadership to and coordination of all measurement matters, both within CSIRO and more widely.
- The Commonwealth recognise the NML as the peak body within the Australian measurement infrastructure and assign to it responsibility for providing leadership to and coordination of Australia’s measurement system.

One possible way for the irrigation industry to manage this issue is to recognise the AITC as having a similar responsibility and role for measurement within the irrigation industry. The AITC can liaise with the National Measurement Laboratory to ensure that irrigation industry practice complies with national guidelines. The AITC could also coordinate the activities of other testing laboratories which have water measurement capability.

Irrigation industry bodies should monitor and review the operations of the NML and the office of policy within the Federal Department of Industry, Science and Tourism.

4.2 Standards Writing Issues

The Irrigation Association of Australia Ltd has maintained a standards subcommittee for some time. This committee has tried to coordinate the introduction of new standards by identifying the need for the standard and facilitating the writing of the standard. A lack of resources and a volunteer effort has resulted in a low level of activity. However it is clear from the information contained in chapter three that the existence of standards is not as greater an issue as a knowledge of their existence and applicability of standards within the industry. A lack of industry interest or knowledge can arise because of the way in which standards are written. As noted in the Kean Inquiry;

"Industry was critical of the lack of transparency, responsiveness and accountability, the time it takes to write a standard, the lack of rigour in setting priorities and the low rate of adoption of international standards."

As a result a series of recommendations were made in three main areas. These were:

a) A more rigorous approach to establishing the need for a new standard

- Standards Australia should adopt a system which allows for a methodical appraisal of the need for standards and the establishment of an order of priority for developing standards.
- Estimate cost as part of evaluating need and priority
- Standards Australia develop public guidelines which specify the exceptional circumstances under which it would be appropriate to develop a unique national standard rather than adopting an international standard.

b) Clearer separation of responsibility for writing and approving a standard

The Committee recognised the number of instances where the same Standards Australia committee wrote the standard and then approved the same standard. Before the separation of roles many state water utilities filled both of these roles. It is important for the irrigation industry that any standards written, say specifying accuracy of meters measuring supply to farms from authorities, involve all stakeholders including meter manufacturers, irrigators and water supply authorities plus other independent experts as required.

c) Greater involvement by business and other stakeholders

This emphasises the point made in b) above.

An additional way to involve the industry in standards writing is to accredit other standards writers, in addition to those operating under the control of Standards Australia specifically

- establishing a process for accreditation of other standards writers which is entirely independent of its existing procedures for standards writing
- establishing a comparable independent process for approval of standards, both written in house, and by other writers
- establishing for distribution and publication of standards fixed and public procedures and prices which allow for an appropriate return to the standards writer for the intellectual property, and
- establishing a national register of standards, including both voluntary and regulatory standards.

Chapter 5 discusses how some of these recommendations could be implemented within the irrigation industry. The Committee of Inquiry also analysed in detail the various roles of Standards Australia. Many of the recommendations with regard to standards writing were recommendations on the future role of Standards Australia.

4.3 Regulatory Standards and Conformance Issues

It is sometimes suggested that the introduction of regulations is the only way in which the industry will adopt more exacting standards for equipment and services. On the other hand the rapid changes as a result of the introduction of the water reforms have led to significant improvements in water efficiency in some areas. However it is likely that some regulations will be attached to individual irrigator water licences in the same way that water authorities have to comply with certain conditions to maintain their bulk water licence.

In circumstances where a regulatory approach is thought necessary the Kean Committee recommended that certain principles be followed when establishing regulations and conditions of conformance to the regulations. These principles were:

a) Principles for regulatory standards setting
"In general terms the committee leans towards use of performance standards, ie specifications for general minimum performance rather prescriptive standards with much greater detail, also allows national implementation rather than jurisdiction by jurisdiction."

This approach is taken in the standard for irrigation drippers. The standard classifies drippers according to their physical performance. The standard is written in such a way that the classification of drippers according to performance provides critical information to a potential buyer about the dripper.

b) Conformance requirements

If legislation is introduced to cover the conditions of supply of irrigation water to irrigators and one of the conditions relates to the allowable accuracy of the meters used to measure the flow to the farm the following principles have been recommended.

"The level of compliance should be commensurate with the risk associated with non-compliance; competitive third party testing and certification should be used wherever possible; options should be available for demonstrating compliance; and conformity assessment arrangements should not erect barriers to trade."

"The Commonwealth requires regulatory agencies who use third party certifiers to require JAS-ANZ accreditation and encourage State and Territory Governments to do likewise."

In practice these principles could operate in the following way. Let us assume that a water authority will specify to suppliers that any meters installed to measure water flow onto irrigation farms will conform to certain accuracy requirements. The suppliers will know from the standard what the allowable measurement errors are. They will be able to use a variety of ways to demonstrate to the water authority that their meters meet the required accuracy.

The recommended principles indicate that the manufacturers will have a choice of accredited laboratories for the testing of meters to test accuracy, or they may have introduced a quality assurance scheme which is also independently audited. The key point being that an independent audit of accuracy of the meters is carried out in a systematic way, using an third party. It is important that this process does not disadvantage any supplier and each supplier should have access to a system that provides the quality assurance without the imposition of an unreasonable cost.

4.4 & 4.5 Conformance Issues Relating to NATA and JAS-ANZ,. Quality Management Systems Certification

These two issues are not of great significance to the irrigation industry. In summary they relate to the management and control of the accreditation procedures for laboratories and the control of quality assurance systems. The recommendations from the Committee and the response from Government have established basic rules which the irrigation industry could follow. The key issue for industry was to ensure that there was competition in the provision of systems by which organisations could obtain quality accreditation.

4.6. Marks

Marks have been used by many economies to identify the quality of particular goods. An example is the use of hallmarks for items made from silver and gold. Consumers are familiar with energy ratings applied to domestic electrical appliances. Another example is the water efficiency rating given to plumbing products. A draft proposed system for rating the water efficiency of irrigation equipment has been prepared by the AITC for a report to the Urban Water Research Association of Australia. The system has not been developed since the idea was proposed. The Water Services Association of Australia is keen to explore the issues involved in its implementation but questions of copyright have delayed progress.

The Kean Inquiry faced similar issues and concluded:

“The matter of conformance marks raises highly complex issues and impacts across both the public and private sectors. Satisfactory resolution of these issues will require wide consultation with all relevant interest groups, including governments, industry, key infrastructure agencies and consumer groups.”

The government response to these recommendations was as follows:

“In the voluntary sector it will be asked to examine and develop recommendations on the desirability and feasibility of establishing a new system of marks based on the following principles identified by the Kean Committee, namely, that such marks:

- be easily recognisable
- be clear as to function
- be used only on nominated goods and services as licensed

- be available through all accredited certification bodies, and
- be used in conjunction with the logo of accredited certifiers"

Adherence to these principles in the irrigation industry would require an unprecedented degree of communication and cooperation between the full range of interested parties. It is suggested that the intent of marks could be achieved by other strategies in the irrigation industry.

A number of studies have shown that the management and operation of an irrigation system have a much greater impact on the efficiency of operation than does the quality of equipment that used in the system. This applies whether the system is gravity fed or pressurised. If the industry wishes to improve the general level of performance in all aspects of the industry it is likely to achieve more by encouraging the adoption of quality management systems rather than encouraging the use of a system of marks.

It is possible however that a system of marks could be used for specific pieces of equipment which are universal in their use. For example water meters might be marked if they have been tested to a specific standard. It is more likely that equipment whose proper functioning is critical to the system in which it is installed will have been subjected to the testing associated with a standard.

4.7. Issues relating to Coordination and Strategic Direction

The final issue covered by the Kean Inquiry was the ongoing issue of how to ensure the continuing efficient operation of the conformance infrastructure that it proposed. It defined certain roles for Federal and State Departments and for quality certification organisations. Its main recommendation was the formation of an Advisory Council to provide input to Government on the functioning of the various organisations. Chapter 5 discusses how strategic and coordination issues could be managed in the irrigation industry.

5 MANAGEMENT OF STANDARDS AND CODES WITHIN THE IRRIGATION INDUSTRY

The Australian Irrigation Council (AIC) is the logical organisation to which a subcommittee could be formed to manager standards in the industry. However the AIC is a relatively young organisation which is still establishing its place within the industry. Any projects or tasks it undertakes are completed by one of the three constituent organisations. In the area of standards and codes the Irrigation Association of Australia (IAA) maintains a standards committee which is recognised by Standards Australia as representing the irrigation industry. The IAA committee is also a corresponding member of the ISO committee which manages international development of standards in this area. The IAA has also been responsible for the publication of a series of design guidelines, it also maintains a website which describes the association's activities in the area of standards. However the committee is staffed by volunteers and meets infrequently. Notwithstanding this the existence of the committee makes this the logical industry body to supervise and coordinate the work.

The key activities which should be completed if the industry is to take advantage of the potential benefits of widespread use of standards and codes are:

- Develop an effective system for developing codes
- Ensure easy industry access to public documents
- Ensure all documents written are relevant and of value to the industry
- Endure industry ownership of the standards development process and of published standards and codes.

The IAA committee provides a base from which to begin these activities but the other partner organisations should be closely involved. In particular ANCID has international linkages which are an important source of technical documents, some of which are design guidelines, if not prescribed standards. It is recommended that a suggestion be made to IAA and ANCID that they cooperate on the development of standards and codes for the irrigation industry. However in addition to establishing a cooperation at an organisational level it is critical that other key groups and individuals in the industry, understand, have access to and can participate in the processes of the "industry standards committee". This will require wide publication of activities in this area to ensure adequate industry ownership.

Systems already exist to enable industry to own a new or growing initiative but these systems need to be supported better than they are at present.

Appendix 1. Existing standards and codes

Prefixes

International Organization for Standardization : ISO = International standard
DIS = Draft international standard
TR = Technical report

Standards Australia : AS = Australian standard
AS/NZS = Joint Australian/New Zealand standard

American Society of Agricultural Engineers (ASAE) : EP = Engineering practice
S = Standard
X = under development * = under revision

Water Supply and Storage

		ISBN
*EP400.2T	Designing and Constructing Irrigation Wells.	
Water Storage for Irrigation (IAA - draft stalled)		
Farm water supplies design manual. QLD Water Resources Commission. (Now Department of Natural Resources) Edited by Horton and Jobling		
Vol 1. Farm storages		0 7242 5090 5
Groundwater pumping handbook. RWC/DAV. Edition 2 1993		
Groundwater and wells. FS Driscoll. Edition 2 1987		
Australian drilling manual. ADITC. Edition 3 1992		

Pumps

AS 2417.1-1980	Pumps-The international acceptance test codes - Application	0 7262 2094 9 0 7262 2139 2
AS 2417.2-1980	- Class C tests - Class B tests	0 7262 2140 6
AS 2417.3-1980		
X438, X569	Minimum requirements for pumping plants	
Farm water supplies design manual. QLD Water Resources Commission. (Now Department of Natural Resources). Vol 3. Drainage and pumps		
Groundwater pumping handbook. RWC/DAV. Edition 2 1993		

Filters

ISO/DIS 9912-1	Filters- Part 1: Classification
ISO 9912-2:1992	Filters- Part 2: Strainer-type filters
ISO 9912-3:1992	Filters- Part 3: Automatic self-cleaning strainer-type filters
S539	Media Filters for Irrigation- Testing and Performance Reporting

Irrigation and Drainage Pipes and Fittings

General

ISO TR 10501	Thermoplastics pipes for transport of liquid under pressure-Calculation of head losses	
AS 2566-1982	Plastics pipelaying design	0 7262 2679 3
AS 1745.1-1989	Outdoor weathering of plastics in the Australian environment -Commercial products	0 7262 5586 6
AS 1745.2-1989	-Guide for design purposes	0 7262 5699 4
AS 1272-1974	Unsintered PTFE tape for thread sealing applications	0 7262 0329 7
AS 2620.1-1983	Domestic garden hose - reinforced hose	0 7262 2973 3
AS 2620.2-1983	Domestic garden hose - unreinforced hose	0 7262 2974 1
AS 2129-1994	Flanges for pipes, valves and fittings	0 7262 8890 X
AS 1646-1992	Elastometric seals for waterworks purposes	0 7262 7532 8
AS 2528-1982	Bolts, studbolts and nuts for flanges and other high and low temperature applications (ISO 225, ISO 272, ISO 885, ISO 888, ISO 898-1,and ISO 4759-1)	0 7262 2465 0
AS 3707-1989	Method for testing pressure cycling resistance of pipes and fittings (and amendment 1)	0 7262 5767 2 0 7262 6490 3
*S376.1	Design, Installation and Performance of Underground, Thermoplastic Irrigation Pipelines	

Unplasticized Polyvinyl chloride (uPVC)

ISO/DIS 4422	Pipes and fittings in PVCU pipes for water supply : Specification	
AS 1477-1996	PVC pipes and fittings for pressure applications	0 7337 0249 X
AS 1254-1991	Unplasticised PVC (UPVC) pipes and fittings for storm and surface water applications	0 7262 6817 8
AS 1273-1991	Unplasticised PVC (UPVC) downpipe and fittings for rainwater	0 7262 6781 3
AS 2032-1977	Code of practice for installation of UPVC pipe systems	0 7262 1243 1
AS/NZS 3879:1995	Solvent cements and priming fluids for use with unplasticized PVC (uPVC) pipes and fittings	0 7262 9775 5
AS 1462.1-1996	Method for determining the dimensions of pipes and fittings	0 7337 0344 5
AS 1462.2-1984	Method for determining the flattening properties of UPVC pipes	
AS 1462.3-1988	Method for determining the impact characteristics of UPVC pipes	0 7262 5163 1

AS 1462.4-1984	Method for determining reversion of UPVC pipes	
AS 1462.5-1984	Method for determining the softening point of UPVC pipes and fittings	
AS 1462.6-1989	Method for hydrostatic pressure testing of UPVC pipes	0 7262 5450 9
AS 1462.7-1984	Method for determining the extractability of lead and tin from UPVC pipes and fittings	
AS 1462.8-1984	Method of test for liquid infiltration	
AS 1462.9-1984	Method of hydrostatic pressure testing of UPVC pressure fittings	
AS 1462.10-1984	Method of hydrostatic pressure testing of UPVC non-pressure fittings	
AS 1462.11-1996	Method for high temperature stress-relief testing of fittings	0 7337 0346 1
AS 1462.12-1984	Method for determining the effect of immersion in anhydrous acetone on UPVC pipes	
AS 1462.13-1974	Method for determination of compression characteristics of a rubber ring joint for resistance to root penetration	
AS 1462.14-1996	Method for determination of the light transmission of pipe	0 7337 0347 X
AS 1462.15-1996	Method for determination of vinyl chloride monomer content	0 7337 0348 8
AS 1462.16-1996	Method for high temperature testing of pipe	0 7337 0349 6
AS 1462.17-1988	Method for testing pressure pipe joints with elastomeric seals	0 7262 5164 X
AS 1462.18-1988	Methods for determination of PVC and titanium dioxide content	0 7262 4822 3
AS 1462.20-1996	Method for determination of long-term failure stress of PVC moulding compounds	0 7337 0350 X
X437	PVC aboveground irrigation pipe	

Polyethylene

ISO/DIS 4427	Pipes and fittings in PE pipes for water supply : Specification	
ISO/DIS 7426	PE pipe work for the conveyance of water under pressure	
ISO 8779:1992	Polyethylene (PE) pipes for irrigation laterals- Specifications	
ISO 8796:1989	Polyethylene (PE) 25 pipes for irrigation laterals- Susceptibility to environmental stress-cracking induced by insert-type fittings-test method and specification	
ISO 9625:1993	Mechanical joint fittings for use with polyethylene pressure pipes for irrigation purposes	
ISO/DIS 13460	Plastic saddles for polyethylene pressure pipes	
AS 1463-1988	Polyethylene pipe extrusion compounds	0 7262 4931 9
AS 2033-1980	Installation of polyethylene pipe systems	0 7262 1244 X

AS 2439.1-1981	Perforated drainage pipe and associated fittings	0 7262 2180 5
AS 2492-1994	Cross-linked polyethylene (PE-X) pipe for hot and cold water applications	0 7262 9281 8
AS 2537-1994	Mechanical jointing fittings for use with cross-linked polyethylene (PE-X) pipe for hot and cold water applications	0 7262 9282 6
AS 1159-1988	Polyethylene pipes for pressure applications (Superseded by AS/NZS 4130)	0 7262 4924 6
AS 2698.1-1984	Plastics and pipes for irrigation and rural applications. Part 1. Polyethylene micro-irrigation pipe	0 7262 3431 1
AS 2698.2-1985	Part 2. Polyethylene rural pipe.	0 7262 3755 8
AS 2698.3-1990	Part 3. Mechanical joint fittings for use with polyethylene micro-irrigation pipes	0 7262 6010 X
AS 1460.1-1989	Fittings for use with polyethylene pipes. Part 1. Mechanical jointing fittings	0 7262 5652 8
AS 1460.2-1989	Fittings for use with polyethylene pipes. Part 2. Electrofusion fittings	0 7262 5653 6
AS/NZS 4130:1997	Polyethylene (PE) pipes for pressure applications	0 7337 1086 7
AS/NZS 4131:1997	Polyethylene (PE) compounds for pressure pipes and fittings	0 7337 1087 5
X435	Polyethylene pipe used for microirrigation laterals	
	Acrylonitrile butadiene styrene (ABS)	
AS 3518.1-1988	Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications - Pipes	0 7262 4797 9
AS 3518.2-1988	Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications - Solvent cement fittings	0 7262 4798 7
AS 3690-1989	Installation of ABS pipe systems	0 7262 5798 2
AS 3691-1989	Solvent cement and priming (cleaning) fluids for use with ABS pipes and fittings	0 7262 5769 9
	Glass reinforced plastic (GRP)	
AS 3571-1989	Glass filament reinforced plastics (GRP) pipes - polyester based -Water supply, sewerage and drainage applications	0 7262 5219 0
AS 3572.4-1989	Determination of the dimensions of glass filament reinforced plastics pipes	0 7262 5326 X
AS 3572.5-1989	Determination of hoop tensile strength of wound glass filament reinforced plastics pipes	0 7262 5327 8
AS 3572.6-1989	Determination of hoop tensile modulus of elasticity of wound glass filament reinforced plastics pipes	0 7262 5330 8
AS 3572.8-1989	Determination of long-term ring stiffness of glass filament reinforced plastics pipes (and amendment 1)	0 7262 5332 4 0 7262 6315 X

AS 3572.9-1989	Determination of pressure regression characteristics as a fuction of time for glass filament reinforced plastics pipes	0 7262 5333 2
AS 3572.10-1989	Determination of the initial ring stiffness of glass filament reinforced plastics pipes (and amendment 1)	0 7262 5334 0 0 7262 6314 1
AS 3572.11-1989	Determination of the initial ring deflection of glass filament reinforced plastics pipes (and amendment 1)	0 7262 5335 9 0 7262 6316 8
AS 3572.12-1989	Determination of initial failure pressure and initial hoop strength of glass filament reinforced plastics pipes (and amendment 1)	0 7262 5338 3 0 7262 6317 6
AS 3572.13-1989	Determination of the initial longitudinal tensile strength of glass filament reinforced plastics pipes (and amendment 1)	0 7262 5339 1 0 7262 6318 4
AS 3572.14-1989	Determination of the long-term ring deflection of glass filament reinforced plastics pipes subject to constant load and environmental exposure	0 7262 5340 5
AS 3572.15-1989	Determination of resistance to long-term strain corrosion of glass filament reinforced plastics pipes	0 7262 5341 3
AS 3572.16-1989	Testing of flexible joints of glass filament reinforced plastics pipes	0 7262 5342 1

Concrete

ISO/DIS 4482	Asbestos-cement pipelines -Guide for lining	
AS 4058-1992	Precast concrete pipes (pressure and non-pressure) Amendment 1	0 7262 7730 4 0 7337 0247 3
S261.7	Design and Installation of Nonreinforced Concrete Irrigation Pipe Systems	

Steel, iron, copper and other metals

ISO 11678:1996	Aluminium irrigation tubes	
AS 3975-1991	Aluminium alloys - Irrigation tube	0 7262 7079 2
AS 4041-1992	Pressure piping (and amendment 1)	0 7262 7596 4 0 7262 9150 1
AS 4087-1996	Metallic flanges for waterworks purposes	0 7337 0458 1
*S263.3	Minimum standards for Aluminium Sprinkler Irrigation Tubing	

Valves and regulators

ISO/DIS 10631	Metallic butterfly valves for general purposes
ISO 7714:1995	Volumetric Valves- General requirements and test methods

ISO 9393-1:1994	Thermoplastic valves- Pressure test methods and requirements - Part 1: General	
ISO 9635:1990	Irrigation equipment- Hydraulically operated irrigation valves	
ISO 9644:1993	Pressure losses in irrigation valves-Test method	
ISO 9911:1993	Manually operated small plastics valves	
ISO 9952:1993	Check valves	
ISO 10522:1993	Direct-acting pressure-regulating valves	
ISO/DIS 11419	Float-type air release valves	
AS 2129-1994	Flanges for pipes, valves and fittings	0 7262 8890 X
AS 2528-1982	Bolts, studbolts and nuts for flanges and other high and low temperature applications (ISO 225, ISO 272, ISO 885, ISO 888, ISO 898-1,and ISO 4759-1)	0 7262 2465 0
AS 2845.1-1995	Water Supply- Backflow prevention devices. Part 1. Materials, design and performance requirements	0 7262 9522 1
AS 2845.2-1996	Water Supply- Backflow prevention devices. Part 2. Air gaps and break tanks	0 7337 0758 0
AS 2845.3-1993	Water Supply- Backflow prevention devices. Part 3. Field testing and maintenance	0 7262 8331 2
AS 1628-1994	Water supply - Copper alloy gate, globe and non-return valves (and amendment 1)	0 7262 8787 3 0 7337 9785 8
AS 3578-1993	Cast iron non-return valves for general purposes	0 7262 8471 8
AS 3579-1993	Cast iron wedge gate valves for general purposes	0 7262 8469 6
X512	Pressure regulator testing procedures	
*S447	Procedure for Testing and Reporting Pressure Losses in Irrigation Valves	
ISO/DIS 11738	Control heads	

Sprinklers, sprayers and emitters

ISO 7749-1:1995	Rotating Sprinklers- Part 1:Design and operational requirements.
ISO 7749-2:1990	Rotating Sprinklers- Part 2:Uniformity of distribution and test methods
ISO 8026:1995	Sprayers-General requirements and test methods
ISO 9260:1991	Emitters- Specification and test methods
ISO 9261:1991	Emitting Pipe Systems- Specification and test methods
ISO 11545:1995	Centre-pivot and moving lateral machines with sprayer or sprinkler nozzles- Determination of uniformity of water distribution
S330.1	Procedure for Sprinkler Distribution Testing for Research Purposes
S398.1	Procedure for Sprinkler Testing and Performance Reporting.
*S436	Test Procedure for Determining the Uniformity of Water Distribution of Centre Pivot, Corner Pivot and Moving Lateral Irrigation Machines Equipped with Spray or Sprinkler Nozzles
*EP 458	Field Evaluation of Microirrigation Systems
X439	Procedure for testing and reporting low pressure spray distribution device performance as used on mechanical move irrigation
X531	Planning, design, operation and management of low energy precision application (LEPA) irrigation systems
X553	Performance testing and reporting for thin-walled emitting (drip) tubes

Standard for the Testing of Micro-irrigation Sprayers

Drip and Microirrigation for Trees, Vines and Row Crops - C.M. Burt and S.W. Styles		0 9643634 0 2
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Irrigation Systems and Water Application Efficiencies - Irrigation Australia, Autumn 1993, Vol 8, No 1 (6-11)		
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ISO 8224-2:1991	Traveller irrigation machines - Part 2: Softwall hose and couplings- Test methods
ISO 11545:1995	Centre-pivot and moving lateral machines with sprayer or sprinkler nozzles- Determination of uniformity of water distribution
*S436	Test Procedure for Determining the Uniformity of Water Distribution of Centre Pivot, Corner Pivot and Moving Lateral Irrigation Machines Equipped with Spray or Sprinkler Nozzles
S394	Specifications for Irrigation Hose and Couplings Used With Self-Propelled, Hose-Drag Agricultural Irrigation Systems.
S395	Safety for Self-Propelled, Hose-Drag Agricultural Irrigation Systems.

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S339	Uniform classification for water hardness	

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Nursery Industry Water management. Best Practice Guidelines. Australia 1997		0 646 31160 3
Crop water requirements. FAO Irrigation & Drainage paper 24 (1997 + rev)		

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AS 2200-1978	Design charts for water supply and sewerage	0 7262 1535 X

AS 3735-1991	Concrete structures for retaining liquids	0 7262 6772 4
EP260.4	Design and construction of subsurface drains in humid areas	
S268.4	Design, layout, construction and maintenance of terrace systems	
EP302.4	Design and construction of surface drainage systems on agricultural lands in humid areas	
S422	Mapping symbols and nomenclature for erosion and sediment control plans for land disturbing activities	
S491	Graphic symbols for pressurized irrigation system design	
*EP267.6	Principles and Practice for Prevention of Mosquito Sources Associated with Irrigation	
EP419.1	Evaluation of Irrigation Furrows	
*EP 458	Field Evaluation of Microirrigation Systems	
EP 479	Design, Installation and Operation of Water Table Management Systems for Subirrigation/Controlled Drainage in Humid Regions	
*EP405.1	Design and Installation of Microirrigation Systems.	
X492	Design, construction and maintenance of diversions	
X480	Design of subsurface drains in humid areas (to replace EP260.4)	
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Irrigation Systems and Industry Standards - Denis Sparrow		
Design Charts - Rural Water Advisory Services (Queensland Dept of Primary Industries)		
Design Criteria for Irrigation Systems - National Capital Development Commission		
Farm water supplies design manual. QLD Water Resources Commission. (Now Department of Natural Resources) Edited by Horton and Jobling		0 7242 5089 1 (Set)
Vol 1. Farm storages		0 7242 5090 5
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Vol 3. Drainage and pumps		
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Whole Farm Planning for Irrigation. Design Guidelines		0 646 07258 7
Landscape Irrigation Design - E.W. Rochester (ASAE Publication no. 8)		0 929355 61 X
Drip and Microirrigation for Trees, Vines and Row Crops - C.M. Burt and S.W. Styles		0 9643634 0 2
The Complete Irrigation Workbook - L. Keeson		1 883751 01 2
The Surface Irrigation Manual - C.M. Burt		0 9639016
Turf Irrigation Manual - R.B. Choate		0 9635096 0 8

Earthworks and Drainage

AS 1726-1993	Geotechnical site investigations (and amendments 1 & 2)	0 7262 7878 5 0 7262 8815 2 0 7262 9117 X
S313.2	Soil cone penetrometer	
*EP 340.2	Installation of flexible membrane linings	
S442	Water and sediment control basins	
EP463.1	Design, Construction and Maintenance of Subsurface Drains in Arid and Semi-Arid Areas	
*S289.1	Concrete Slip-Form Canal Linings	
*EP407.1	Agricultural Drainage Outlets - Open Channels	
X542	Methods and procedures of using the soil cone penetrometer	
X425	Underground outlets for conservation practices	
X464	Grassed waterways for agricultural runoff	
X492	Design, construction and maintenance of diversions	
X480	Design of subsurface drains in humid areas (to replace EP260.4)	
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X507	Operation of controlled drainage systems	
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Vol 3. Drainage and pumps
Groundwater and wells. FS Driscoll. Edition 2 1987
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Meters, Measurement and Automation

ISO 3951	Sampling procedures	
ISO 4064/1-1977	Measurement of water flow in closed conduits - Meters for cold potable water Part 1: Specification	
ISO 5168-1978 BS 5844 (1980)	Measurement of fluid flow :Estimation of uncertainty of a flow-rate measurement	
ISO 7714:1995	Volumetric Valves- General requirements and test methods	
ISO/TR 8059-1986	Irrigation Equipment-Automatic irrigation systems- Hydraulic control	
ISO 10573:1995	Soil quality- Determination of water content in the unsaturated zone - Neutron depth probe method	
AS 1349-1986	Bourdon tube pressure and vacuum gauges	0 7262 4318 3
X505	Measurement and reporting procedures for automated agricultural weather stations	

Training

National Competency Standards For Irrigation - Australian Irrigation Training Project

Electrical Installations

AS/NZS 2053.1 1995	Conduits and fittings for electrical installations - General requirements	0 7262 9441 1
AS/NZS 2053.2:1995	Rigid plain conduits and fittings of insulating material	0 7262 9442 X
AS/NZS 2053.3:1995	Rigid plain conduits and fittings of fibre-reinforced concrete material	0 7262 9443 8
AS/NZS 2053.4:1995	Flexible plain conduits and fittings of insulating material	0 7262 9444 6
AS/NZS 2053.5:1995	Corrugated conduits and fittings of insulating material	0 7262 9445 4
AS/NZS 2053.6:1995	Profile-wall, smooth-bore conduits and fittings of insulating material	0 7262 9446 2
AS/NZS 2053.7:1995	Rigid metal conduits and fittings	0 7262 9447 0
AS/NZS 2053.8:1995	Flexible conduits and fittings of metal or composite material	0 7262 9449 7
ISO 12734:1995	Agricultural irrigation- Wiring and equipment for electrically driven or controlled irrigation machines	
S362.2	Wiring and Equipment for Electrically Driven or Controlled Irrigation Machines	
*EP409.1	Safety Devices for Chemigation	
S397.2	Electrical Service and Equipment for Irrigation	

Plumbing and Construction

AS 1170.1-1989	Minimum design loads on structures (known as SAA Loading Code) and amendment 1	0 7262 5501 7 0 7262 8019 4
AS 1547-1994	Disposal systems for effluent from domestic premises	0 7262 9221 4
AS 3500.0-1992	National Plumbing and Drainage code-Glossary of terms	0 7262 6436 9
AS 3500.1-1992	National Plumbing and Drainage code-Water Supply	0 7262 7945 5
AS 3600-1994	Concrete structures	0 7262 9082 3
AS 3725-1989	Loads on buried concrete pipes	0 7262 5945 4
AS 3735-1991	Concrete structures for retaining liquids	0 7262 6772 4

Health and Safety

AS 1470-1986	Health and safety at work - principles and practices	0 7262 4413 9
*EP267.6	Principles and Practice for Prevention of Mosquito Sources Associated with Irrigation	
S395	Safety for Self-Propelled, Hose-Drag Agricultural Irrigation Systems.	
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General

Irrigation for Profit - Water Force Queensland	0 646 00207 4
Irrigation for Profit - Water Force Victoria	0 7316 7478 2

Irrigation for Profit - Water Force New South Wales	
Urban Irrigation. Commercial Turf Irrigation - Irrigation Association of Australia (WA Branch)	
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MIA Land and Water management plan- On farm options	
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The Complete Irrigation Workbook - L. Keeson	1 883751 01 2
The Surface Irrigation Manual - C.M. Burt	0 9639016
Turf Irrigation Manual - R.B. Choate	0 9635096 0 8
Irrigation (Fifth edition) The Irrigation Association	
Australian Cotton Industry - Best Management Practices Manual	

Appendix 2. Contact Details for Standards Associations

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Northern Territory: c/- Territory Construction Association, 191 Stuart Highway, Parap NT 0820
Tasmania: Suite 2, 237 Elizabeth St, North Hobart TAS 7000

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