DVGW-W 392
The German Water Loss Guidelines

Overview of the W 392 – and a comparison with the previous German regulations

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Background

- Advanced leakage management was never an issue in Germany
- The old DVGW guidelines (valid until 2003) were from the early 80s
- W392 is revolutionary for Germany and did only happen because of the close co-operation within the IWA WLTF

W392 and its predecessors

- W 392 - Network inspection and water losses - activities, procedures and assessments replaces three old guidelines, namely
  - W 390 - Control of Water Supply Networks
  - W 391 - Water Losses in Water Distribution Systems
  - W 393 - Leak Detection Methods for Water Pipelines

Structure of the W 392

1. Applicability
2. Standards and legal framework
3. Principles
4. Inspection of water supply systems
5. Water losses in water supply networks
6. Methods and measures for monitoring and reduction of real losses
7. Appendices

Chapter 4: Inspection

- A comprehensive table of periodic inspections and maintenance measures
- Leakage Inspection frequency table:

Level of Real Losses	Recommended Leak Survey Frequency
High	Annually
Medium	Every 3 years
Low	Maximum every 6 years

Chapter 5: Water Losses

- *"A precondition for any discussion of water losses are exact definitions of the components of the water balance."*

Water Balance (German)

Rohrnetz-einspeisung	Rohrnetz-abgabe	In Rechnung gestellte Rohrnetzabgabe	In Rechnung gestellte und gemessene Rohrnetzabgabe	In Rechung gestellte Wasserabgabe
			In Rechnung gestellte und nicht gemessene Rohrnetzabgabe	
		Nicht in Rechnung gestellte Rohrnetzabgabe	Nicht in Rechnung gestellte und gemessene Rohrnetzabgabe	Nicht in Rechnung gestellte Wasserabgabe
			Nicht in Rechnung gestellte und nicht gemessene Rohrnetzabgabe	
	Wasser-verluste	Scheinbare Wasserverluste	Zählerabweichungen, Abgrenzungsverluste bei Ablesung	
			Schleichverluste	
			Wasserdiebstahl	
		Reale Wasserverluste	Zubringerleitungen	
			Behälter	
			Haupt- und Versorgungsleitungen	
			Hausanschlussleitung bis zum Hauswasserzähler	

Chapter 5: Water Losses

- *"A precondition for any discussion of water losses are exact definitions of the components of the water balance."*
- IWA standard water balance and definitions included
- major improvement to W 391 – stated only that a water balance has to be established
- Interesting is how the understanding of the reasons for real losses has changed:

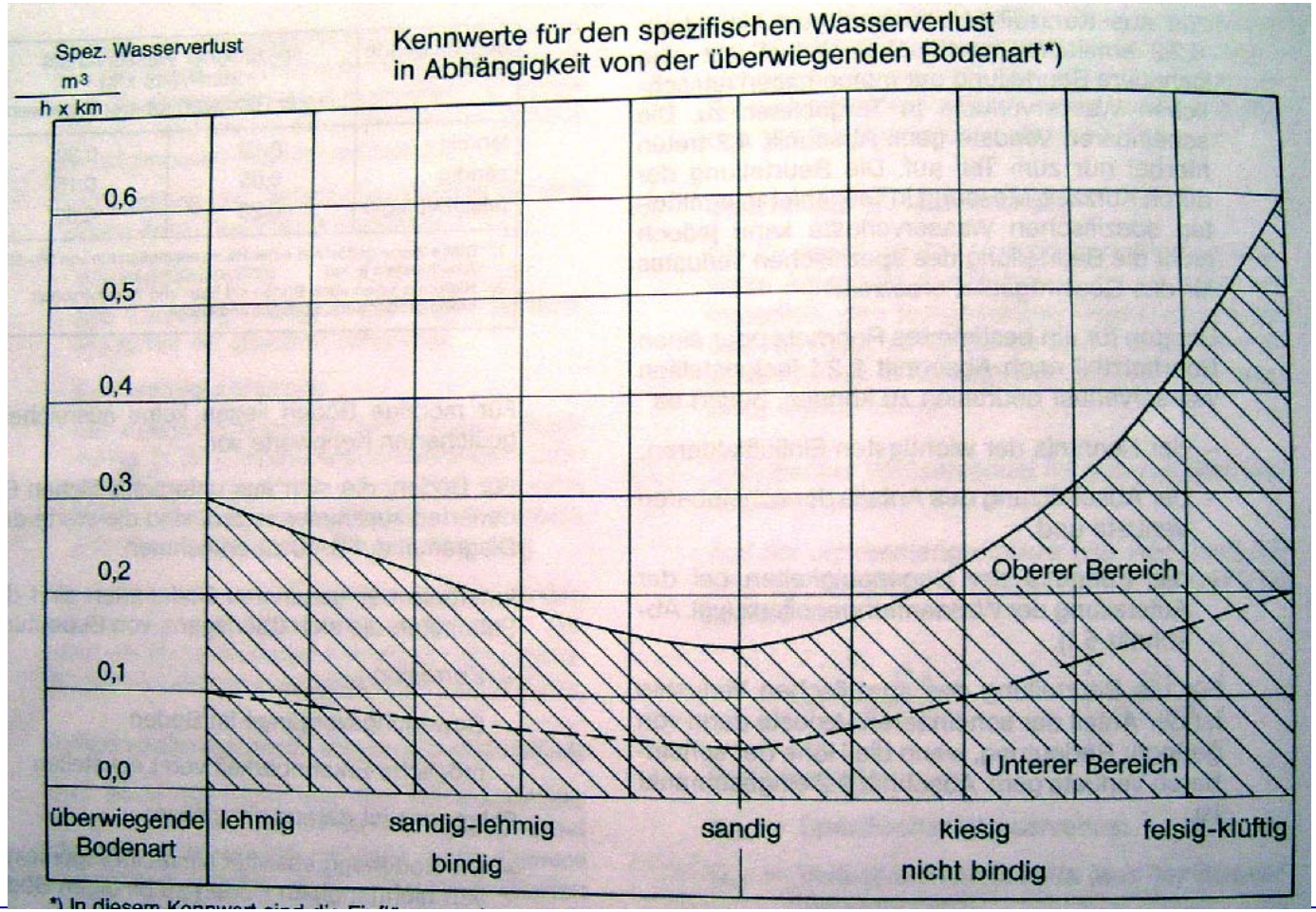
W 392 / W 391 Comparison (1)

W 392	(Old) W 391
Volume of water lost from a leak depends on flow rate and runtime	Not mentioned
Changes in pressure result in changes in leakage in a nearly linear relationship.	Higher operating pressures do normally NOT lead to higher levels of leakage (!)

W 392 / W 391 Comparison (2)

W 392	(Old) W 391
Soil: 3 parameters are relevant: ▪Aggressiveness ▪type (texture) of soil ▪visibility of leaks ▪leaks often don't surface in gravel and permeable rock	Type (texture) of soil is the MOST IMPORTANT influencing factor. Levels of unavoidable real losses (m3/h per km mains), depending on soil type, were listed in a table and a diagram (to be used for mixed soil conditions).

The Famous W 391 Soil/Leakage Chart



W 392 / W 391 Comparison (3)

W 392	(Old) W 391
Has been removed	Influencing factors with only LIMITED RELEVANCE: ▪ pressure ▪ average diameter ▪ pipe materials and types of joints ▪ density of fittings ▪ pipe depth ▪ type of bedding

Like W 391, W 392 discourages the use of percentages

- ... *is unsuitable as a technical performance indicator*
- ... *will always favour systems with high system input*
- ... recommended: m3/km/h
- mentions: ... *internationally often used unit m3/per service connection per day*

Real Loss Targets in W 392

Level of Real Losses [m3/km/h]	Network Structure		
	Type 1 Urban - large cities	Type 2 Urban	Type 3 Rural
Low	< 0.10	< 0.07	< 0.05
Medium	0.10 – 0.20	0.07 – 0.15	0.05 – 0.10
High	> 0.20	> 0.15	> 0.10

Target Analysis

- Background information from:

  German National Report (Weimer D. 2001), Berlin
- Average operating pressure in Germany assumed to be 30m
- Connection density that formed the basis for the W 392:
  - Type 1: > 40 [connections per km mains]
  - Type 2: 25 - 40 per km
  - Type 3: < 25 per km

Targets interpreted by using l/conn./d

Level of Real Losses [l/conn./d]	Network Structure		
	Type 1 Urban - large cities	Type 2 Urban	Type 3 Rural
Connection density used for calculation	50	37.5	25
Low	< 48	< 45	< 48
Medium	48 - 96	45 - 96	48 - 96
High	> 96	> 96	> 96

Targets interpreted by using the ILI

Level of Real Losses [m3/km/h]	Network Structure		
	Type 1 Urban - large cities	Type 2 Urban	Type 3 Rural
Low	< 1.4	< 1.2	< 1.0
Medium	1.4 – 2.8	1.2 – 2.5	1.0 – 2.0
High	> 2.8	> 2.5	> 2.0

Australian Recommendations

ILI	Description
1.0 – 1.5	Excellent
1.5 – 2.0	Good
2.0 – 2.5	Reasonable
2.5 – 3.0	Fair
3.0 – 3.5	Poor
3.5 – 4.0	Unacceptable

AWWA - General ILI Targets

arget ILI ange	Water Resources Considerations	Operational Considerations	Financial Considerations
1 - 3	Available resources are greatly limited and are very difficult and/or environmentally unsound to develop	Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand	Water resources are costly to develop or purchase Ability to increase revenues via wa rates is greatly limited due to regulation or low ratepayer affordability
3 - 5	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning	Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place	Water resources can be developed purchased at reasonable expense; Periodic water rate increases can b feasibly effected and are tolerated the customer population
5 - 8	Water resources are plentiful, reliable and easily extracted	Superior reliability capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages	Cost to purchase of obtain/treat wa is low, as are rates charged to customers
reater han 8	While operational and financial considerations may allow a long-term ILI greater than 8, such a level of leakage not an effective utilization of water as a resource. Setting a target level greater than 8 – other than as an incremental goal to a smaller long-term target – is discouraged.		

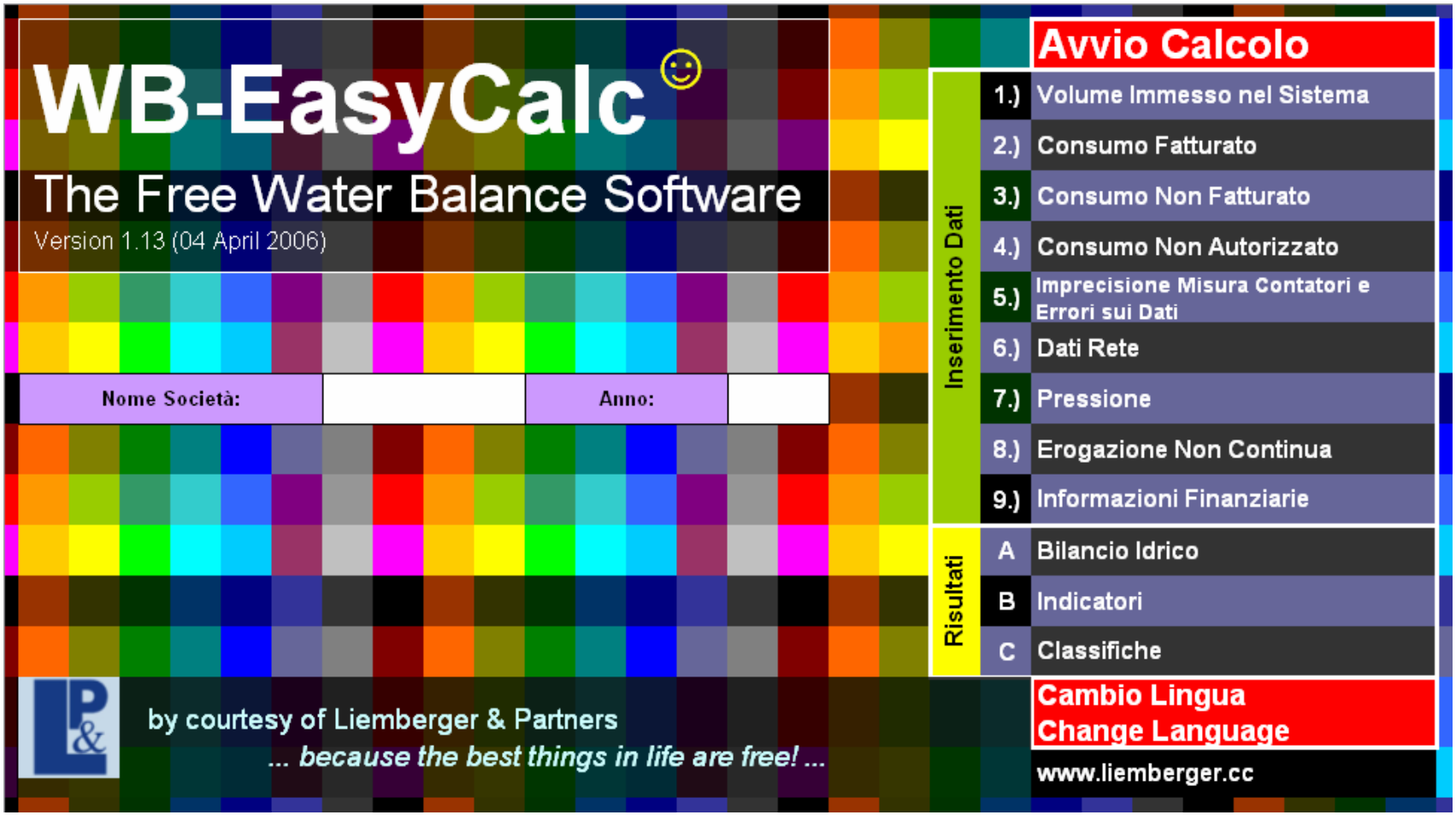
World Bank Institute (WBI)

Technical Performance Category		ILI	Litres/connection/day (when the system is pressurised) at an average pressure of:				
			10 m	20 m	30 m	40 m	50 m
Developed Countries	A	1 - 2		< 50	< 75	< 100	< 125
	B	2 - 4		50-100	75-150	100-200	125-250
	C	4 - 8		100-200	150-300	200-400	250-500
	D	> 8		> 200	> 300	> 400	> 500
Developing Countries	A	1 – 4	< 50	< 100	< 150	< 200	< 250
	B	4 – 8	50-100	100-200	150-300	200-400	250-500
	C	8 - 16	100-200	200-400	300-600	400-800	500-1000
	D	> 16	> 200	> 400	> 600	> 800	> 1000

Real Loss Performance Categories

- **A**: Further loss reduction may be uneconomic unless there are shortages
- **B**: Possibilities for further improvement
- **C**: Tolerable only if resources are plentiful and cheap
- **D**: Inefficient use of resources, indicative of poor maintenance and system condition in general

WB-EasyCalc☺: A Free Multilingual Software



Interesting: The Philosophy

- *"Water loss reduction primarily has to be done for the following reasons:*
  - *Hygiene*
  - *Ensuring sufficient levels of supply*
  - *Safety*
  - *Ecology*
- *and **ONLY** in the case of high water losses there are also economic reasons for reducing them"*

Apparent Losses

- apparent losses should be assessed
- utilities without good data: use 1.5 – 2.0% of *authorised consumption*
- sounds very low but might be explainable as follows:
  - high accuracy customer meters
  - regular meter replacement
  - water pilferage is not an issue
  - reliable meter reading, data handling and billing procedures and systems

Chapter 6: Methods and Measures for Monitoring and Reduction of Real Losses

- develop and implement a strategy that includes:
  - calculation of water loss levels and burst frequencies
  - analysis of water loss levels and their trend (increase/decrease)
  - reduction of awareness, location and repair times
  - active leakage control
  - record keeping
  - asset management (network rehabilitation)

Sensational Recommendation for Germany: DMAs!

- For the execution of real loss control measurements, the distribution network has to be split into small areas
  - one (or more) inflow pipes
  - size shall be determined by the length of mains, which shall be in the range of 4 to 30 km
  - permanent or portable flow meters shall be used
  - the minimum night flow has to be established