LEARNINGS FROM IMPLEMENTING THE IWA METHODOLOGY TO NATIONAL WATER LOSS GUIDELINES

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Bologna, October 2014

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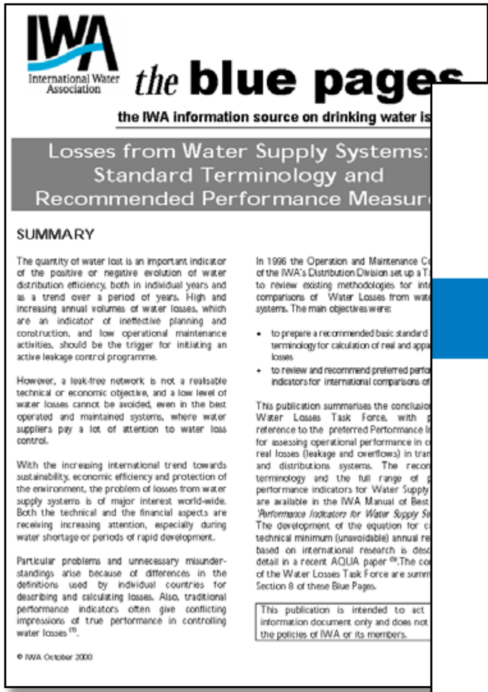
Consulting Engineers
for Water Management and
Environmental Engineering

HISTORY

2000



IWA International Water Association

the **blue pages**

the IWA information source on drinking water is

Losses from Water Supply Systems:
Standard Terminology and
Recommended Performance Measur

SUMMARY

The quantity of water lost is an important indicator of the positive or negative evolution of water distribution efficiency, both in individual years and as a trend over a period of years. High and increasing annual volumes of water losses, which are an indicator of ineffective planning and construction, and low operational maintenance activities, should be the trigger for initiating an active leakage control programme.

However, a leak-free network is not a realisable technical or economic objective, and a low level of water losses cannot be avoided, even in the best operated and maintained systems, where water suppliers pay a lot of attention to water loss control.

With the increasing international trend towards sustainability, economic efficiency and protection of the environment, the problem of losses from water supply systems is of major interest world-wide. Both the technical and the financial aspects are receiving increasing attention, especially during water shortage or periods of rapid development.

Particular problems and unnecessary misunderstandings arise because of differences in the definitions used by individual countries for describing and calculating losses. Also, traditional performance indicators often give conflicting impressions of true performance in controlling water losses [1].

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of the IWA's Distribution Division set up a T
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- to prepare a recommended basic standard
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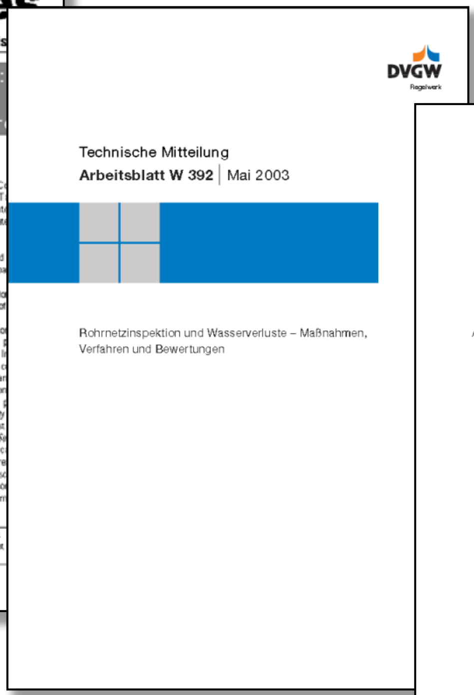
2003



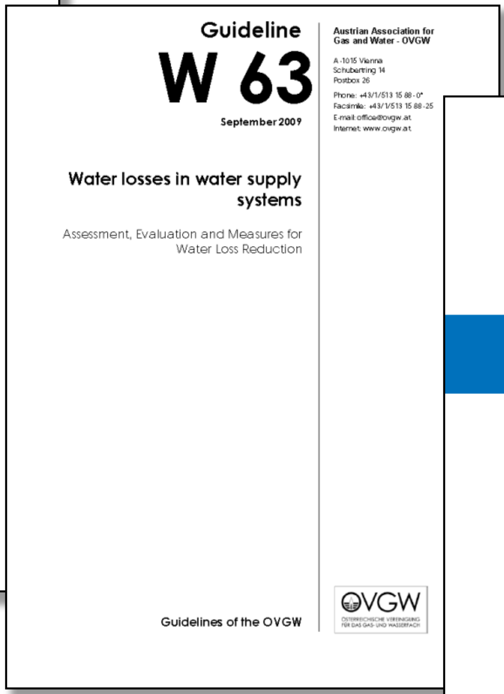
DVGW Regelwerk

Technische Mitteilung

Arbeitsblatt W 392 | Mai 2003

Rohrnetzinspektion und Wasserverluste – Maßnahmen, Verfahren und Bewertungen

2009



Guideline

W 63

September 2009

Water losses in water supply systems

Assessment, Evaluation and Measures for Water Loss Reduction

Guidelines of the OVGW

Austrian Association for Gas and Water - OVGW

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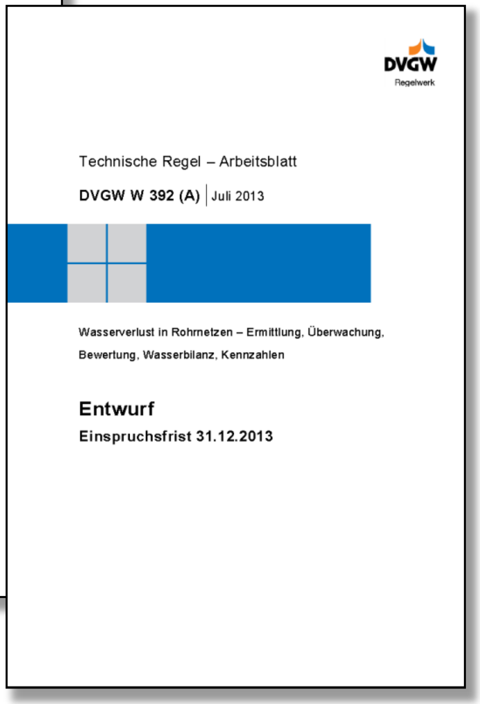
ÖVGW

Draft 07/2013



DVGW Regelwerk

Technische Regel – Arbeitsblatt

DVGW W 392 (A) | Juli 2013

Wasserverlust in Rohrnetzen – Ermittlung, Überwachung, Bewertung, Wasserbilanz, Kennzahlen

Entwurf

Einspruchsfrist 31.12.2013

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IWA BLUE PAGES (2000)

Losses from Water Supply Systems: Standard terminology and Recommended Performance Measures

- IWA Water Balance
- Infrastructure Leakage Index (ILI)

IWA International Water Association

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the IWA information source on drinking water issues

Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures

SUMMARY

The quantity of water lost is an important indicator of the positive or negative evolution of water distribution efficiency, both in individual years and as a trend over a period of years. High and increasing annual volumes of water losses, which are an indicator of ineffective planning and construction, and low operational maintenance activities, should be the trigger for initiating an active leakage control programme.

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Particular problems and unnecessary misunderstandings arise because of differences in the definitions used by individual countries for describing and calculating losses. Also, traditional performance indicators often give conflicting impressions of true performance in controlling water losses [1].

In 1996 the Operation and Maintenance Committee of the IWA's Distribution Division set up a Task Force to review existing methodologies for international comparisons of Water Losses from water supply systems. The main objectives were:

- to prepare a recommended basic standard terminology for calculation of real and apparent losses
- to review and recommend preferred performance indicators for international comparisons of losses.

This publication summarises the conclusions of the Water Losses Task Force, with particular reference to the preferred Performance Indicators for assessing operational performance in control of real losses (leakage and overflows) in transmission and distributions systems. The recommended terminology and the full range of preferred performance indicators for Water Supply Services are available in the IWA Manual of Best Practice *'Performance Indicators for Water Supply Services'* [2]. The development of the equation for calculating technical minimum (unavoidable) annual real losses, based on international research is described in detail in a recent AQUA paper [3]. The conclusions of the Water Losses Task Force are summarised in Section 8 of these Blue Pages.

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System Input Volume M^3/year	Authorised Consumption M^3/year	Billed Authorised Consumption M^3/year	Billed Metered Consumption (including water exported)	Revenue Water M^3/year
			Billed Unmetered * Consumption	
		Unbilled Authorised Consumption M^3/year	Unbilled Metered Consumption	Non-Revenue Water** M^3/year
			Unbilled Unmetered Consumption	
	Water Losses M^3/year	Apparent Losses M^3/year	Unauthorised Consumption	
			Metering Inaccuracies	
		Real Losses M^3/year	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to point of Customer metering	

AUSTRIA – OVGW W 63 (2009)

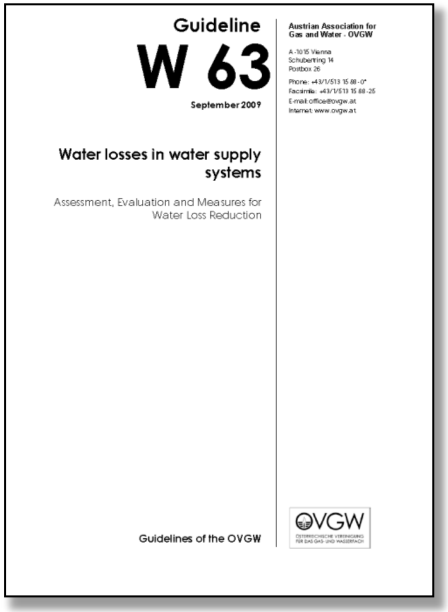
Previous version of OVGW W 63 (1993)

- No standardised IWA Water Balance
- Classification of water losses based on %
- Experiences in OVGW Benchmarking and international developments of IWA WLTF / WLSG lead to revision

Working Group for “new” OVGW W 63 (2009)

- OVGW, Water Utilities, Universities, Industry
- Motivated Team was open for new developments and willing to implement innovative approaches

OVGW W 63 (2009)


Guideline
W 63
September 2009

Water losses in water supply systems

Assessment, Evaluation and Measures for Water Loss Reduction

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ÖVGW

Water Losses in Water Supply Systems: Assessment, Evaluation and Measures for Water Loss Reduction

- IWA Water Balance
- Infrastructure Leakage Index (ILI) as decisive PI
  - Best indicator in terms of considering network parameters (mains, number of connections, length of connections and pressure)
- Class limits (A, B, C, D) same as World Bank Institute Bands (WBI)
- Alternative assessment scheme for q_{AL} Real Losses per Connection per Day (l/conn./d)
- Clear statement against use of %
- Virtual Zone Monitoring
- Recommendations for loss reduction

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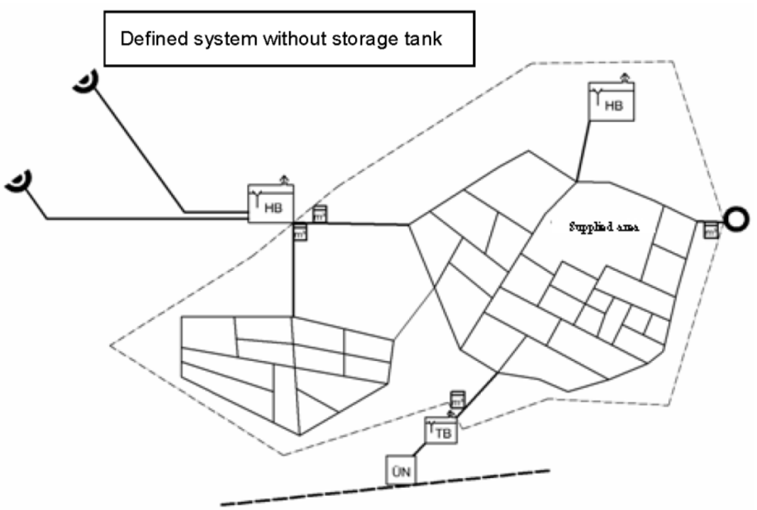
LEARNINGS FROM AUSTRIA - DEFINITIONS

Network or System?

- Water Losses in Water Supply **Systems**: Assessment, Evaluation and Measures for Water Loss Reduction

How difficult is it to define the observed system?

- Storage reservoir in or out?
- Pipes from wells to service reservoir in or out?
- Private pipes in or out?
- …



Source: OVGW W 63 (2009)

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WATER LOSS ASSESSMENT

According WBI classification scheme:

ILI	Class q_{AL}	Evaluation
till 2	A	**very little till little water losses**, further reduction could be counter productive; further analysis before any action should be executed.
2 to 4	B	**medium water losses**, potential for noticeable loss reduction existing, improvement in leakage control and infrastructure management.
4 to 8	C	**high water losses**, volume and reasons for losses have to be analyzed and attempts to reduce the volume of lost water has to be intensified.
greater than 8	D	**very high water losses**, volume and reasons for losses have to be analyzed, distinct leakage control and leakage reduction has to be executed immediately.

Source: OVGW W 63 (2009)

ALTERNATIVE – QUICK ESTIMATE

For l/conn/day:

Density of connection lines (CL/km)	Real losses per connection line and day q_{AL}) (l/CL.d) with an average operating pressure of											
	20 m				30 m				40 m			
10	<110	110-220	220-435	>435	<165	165-325	325-655	>655	<220	220-435	435-870	>870
	A	B	C	D	A	B	C	D	A	B	C	D
15	<85	85-170	170-340	>340	<130	130-255	255-510	>510	<170	170-340	340-680	>680
	A	B	C	D	A	B	C	D	A	B	C	D
20	<75	75-145	145-290	>290	<110	110-220	220-440	>440	<145	145-290	290-585	>585
	A	B	C	D	A	B	C	D	A	B	C	D
30	<60	60-120	120-245	>245	<90	90-185	185-365	>365	<120	120-245	245-490	>490
	A	B	C	D	A	B	C	D	A	B	C	D
40	<55	55-110	110-220	>220	<85	85-165	165-330	>330	<110	110-220	220-440	>440
	A	B	C	D	A	B	C	D	A	B	C	D
50	<50	50-105	105-205	>205	<75	75-155	155-310	>310	<105	105-205	205-410	>410
	A	B	C	D	A	B	C	D	A	B	C	D

Source: Koelbl (2009)

Two other tables for pressure ranges 50 to 70m and 80 to 100 m

LEARNINGS FROM AUSTRIA - ILI

Classification scheme for ILI and l/conn/d works well

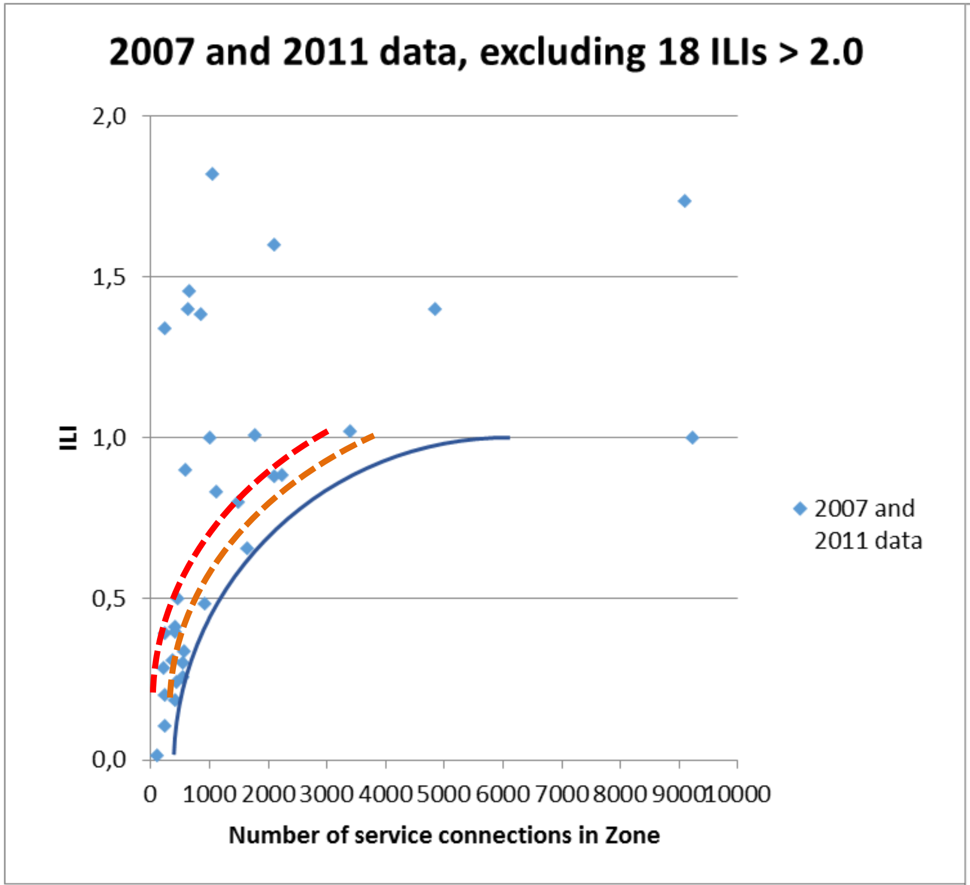
- for systems with > 3000 connections

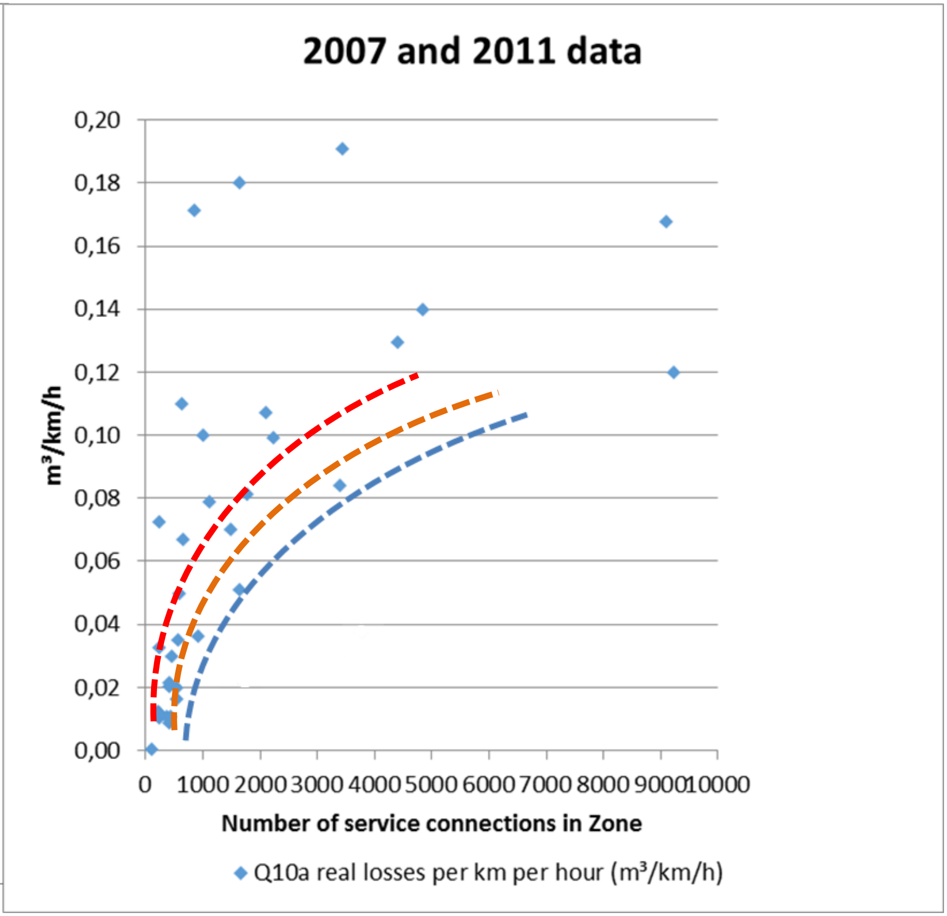
But smaller systems (<3000 service connections) can be in Band A AND achieve ILI < 1.0

- About 90% of Austrian Utilities have less than 3000 conn. (by number, not by volume)
- >80% of these systems have fewer that 1000 connections

- Allan Lambert will go into more detail about this aspect in the next presentation

SIZE MATTERS:
DATA FROM OVGW BENCHMARKING STUDIES





source: Lambert, Koelbl & Fuchs-Hanusch (2014)

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LEARNINGS FROM AUSTRIA – RURAL SYSTEMS

Classification of “rural” systems according DVGW W 392 (2003) methodology ($m^3/km/h$)

Water loss area	Supply system <20 CL/km
Little water loss	< 0,05 m^3/ (km x h)
Medium water loss	0,05 - 0,10 m^3/ (km x h)
High water loss	> 0,10 m^3/ (km x h)

- Not satisfying solution

How can this be resolved?

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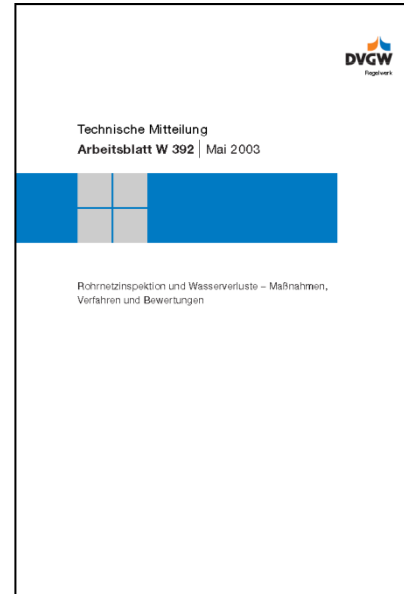
DVGW W 392 (2003)

Network Inspection and Water Losses – Activities, Procedures and Assessment


DVGW

Technische Mitteilung
Arbeitsblatt W 392 | Mai 2003

Rohrnetzinspektion und Wasserverluste – Maßnahmen, Verfahren und Bewertungen

- IWA Water Balance
- Decisive Indicator: q_{VR} (real losses per km mains per hour)
- Real losses as % of system input volume is unsuitable as a technical performance indicator
- Detailed information about network inspection

Level of Real Losses **[m3/km/h]**	Network Structure		
	Area 1 (urban, large cities)	Area 2 (urban)	Area 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

DISCONTINUITY PROBLEMS WITH q_{VR} PERFORMANCE BANDS IN DVGW W 392 (2003)

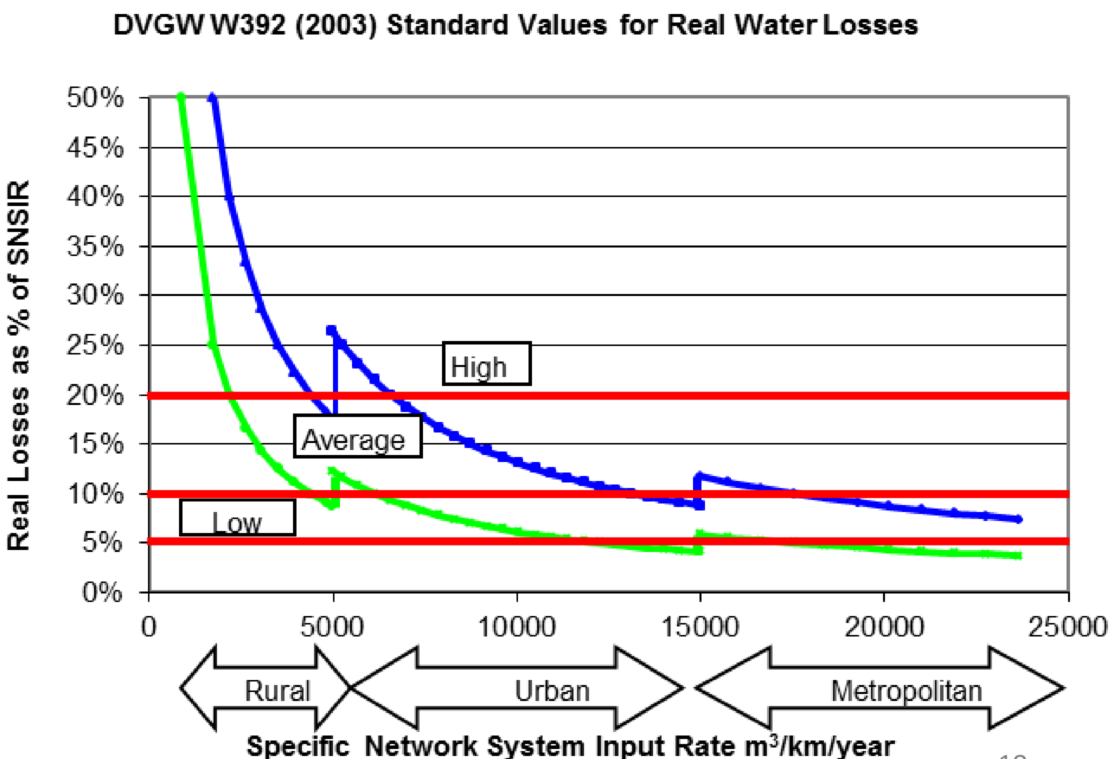
Supply structure based on specific network input rate (m³/km/a) which includes Water Exported

Level of Real Losses [m3/km/h]	Network Structure		
	Area 1 (urban, large cities)	Area 2 (urban)	Area 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

Source: DVGW W 392 (2003, amended)

Discontinuities at the notional boundaries between rural, urban and metropolitan utilities

DVGW Committee became aware of this problem and wants to **remove these "gaps"**



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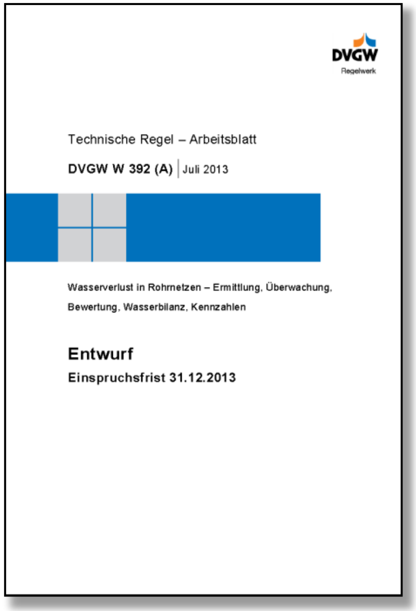
DVGW W 392 (DRAFT 07/2013)

Water Losses in Distribution Networks – Assessment, Monitoring, Classification, Water Balance, Performance Indicators

- IWA Water Balance, slightly amended
- Implementation of ILI as decisive indicator (partly based on Austrian experience)
    - Considers network structure
    - Annual UARL formula (m^3/year)
- m^3/km/h as alternative loss assessment

- Virtual Zone Monitoring described
- Network inspection and maintenance to be included in DVGW W 400-3 (Operation and Maintenance of Networks)



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ILI - Annual UARL Formula

Infrastructure Leakage Index: **ILI = CARL / UARL**

CARL	Currant Annual Real Losses	(m^3/year)
UARL	Unavoidable Annual Real Losses	(m^3/year)

$$\textbf{UARL } (m^3/\text{year}) = (6{,}57 \times Lm + 0{,}256 \times Nc + 9{,}13 \times Lt) \times P$$

Lm	Length of mains (km)
Nc	No. of connections
Lt	Total length of service connections from main to meter (km)
P	Average supply pressure (m)

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TECHNICAL LEAKAGE PERFORMANCE CATEGORIES (LPC) FOR DEVELOPED COUNTRIES

- **Categorise technical performance**
- **Suggest of priority actions**

WBI system 2005

Band	ILI
A	< 2.0
B	2.0 – 4.0
C	4.0 – 8.0
D	> 8

Austrian OVGW descriptions:

A … low

B … medium

C … high

D … very high

LPC/WBI split system

Band	ILI
A1	< 1.5
A2	1.5 ≤ 2.0
B1	2.0 ≤ 3.0
B2	3.0 ≤ 4.0
C1	4.0 ≤ 6.0
C2	6.0 ≤ 8.0
D	8 or more

DVGW draft system

Class	ILI
Low	< 1.5
Medium	1.5 – 2.5
High	2.5 – 3.5
Very High	> 3.5

Challenging limits for “high” and “very high”, under discussion

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LEARNINGS FROM AUSTRIA

Water Balance and Performance Indicators

- Implementing IWA water balance and ILI as decisive PI was a major step
- Even there is a clear statement against % as technical indicator %s are still widely used ☹ - Training for (small) utilities required
- Is a classification scheme needed for very small systems ?

Using ILI bears the risk that higher losses are “hidden” in high pressure systems

- Calculate and always quote average system pressure
- Cross-checks with other performance indicators
- Identify potentials for pressure reduction

Virtual Zone Monitoring methodology described

LEARNINGS FROM GERMANY

Problems and weaknesses of traditional water loss assessment based on $m^3/km/h$

- known and accepted in the meantime - guideline revision in process

Implementing the ILI as decisive PI in Germany

- Major step, other countries might follow

The proposed boundaries for water loss classification in DVGW W 392 (yellow print version 07/2013)

- appropriate in the lower range
  (low water losses at ILI < 1.5)
- but challenging in the upper range
  (high water losses at ILI > 3.5)

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GENERAL LEARNINGS - PIs

Use ILI for the purpose it was developed for

- Assessment and comparisons of Technical Performance in managing Real Losses between different systems with different characteristics
- Keep the calculation as simple as possible
- Annual formula with total service connections length more suitable, easier to understand and faster to calculate

Use m^3/km/h and l/conn/d for the traditional purpose of

- Utility internal monitoring of individual systems/sub-systems
- Utility internal target setting of individual systems/sub-systems
- but **not** for comparisons between systems/sub-systems

LEARNINGS – GUIDELINE PREPARATION

Including all major parties in the guideline development process is essential for broad acceptance

- National Water Associations, Water Utilities, Industry, Universities

Considering national frame conditions

- Legal, environmental and social
- It is often required to change existing (national) practices to internationally proven procedures

Develop European/internationally consistent approaches

- Water balance, performance indicators and boundaries for classification schemes
- Reference to EC Report on Good Practices on Leakage Reduction

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CONCLUSIONS

Implementing a new Water Loss Guideline is always very challenging, but it is a good chance to initiate sector improvement

Thank you

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