



**KOWOTEST**  
Gesellschaft für Prüfausrüstung mbH

SUPPLIERS OF EQUIPMENT FOR INSPECTION

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# KOWOTEST

## Equipment and Accessories for NDT



**XIII. Roncsolásmentes Anyagvizsgáló Konferencia és Kiállítás**

**Eger, 21 – 23 March 2023**

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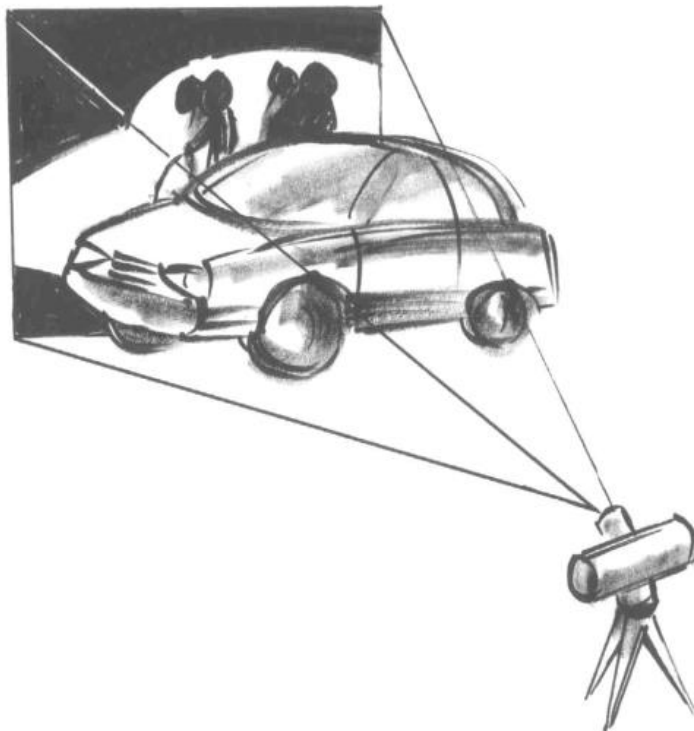
# **DIGITAL RADIOGRAPHY**

**in the light of the  
ISO 9712**

**EN ISO 9712:2021  
Non-destructive testing  
Qualification and certification of NDT personnel**

# Development of X-ray technology exemplary of the most important components

**Detector**



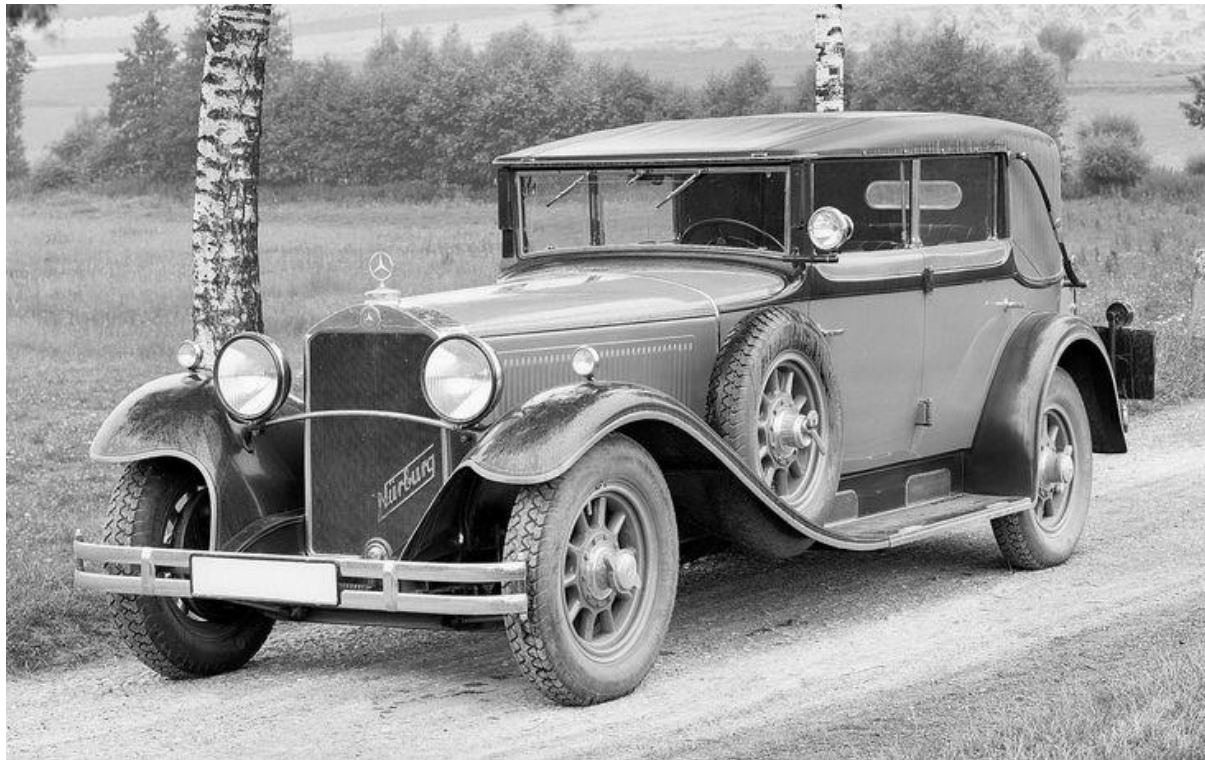
**Radiation Source**

# Radiographic testing

## Image Detectors

- Analog detectors:
  - Radiographic film
  - Image intensifier (CCIR – video standard)
- Digital detectors / techniques:
  - Digitized radiographic film
  - Computed radiography (phosphor plates)
  - Image intensifier (with image processing, HDTV)
  - Flat panel detectors (DDA)

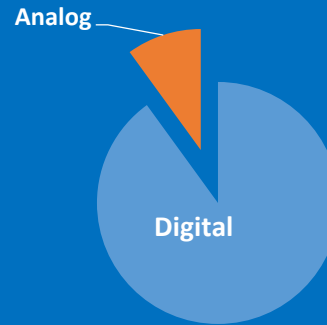
1920 Statement of  
Carl Benz:  
“The car is completely developed.  
What else can come? ”



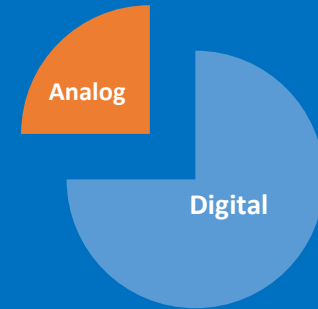


**Why is  
NDT  
so far behind  
other  
markets?**

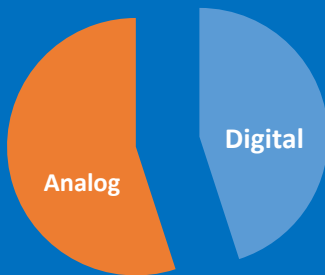
**Consumer  
Photography**



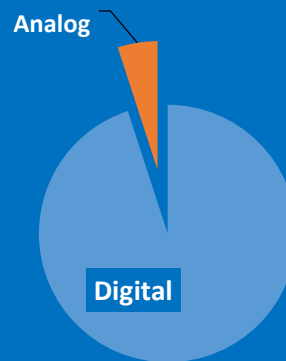
**Medical X-Ray**



**VET X-Ray**



**Graphics/Media**

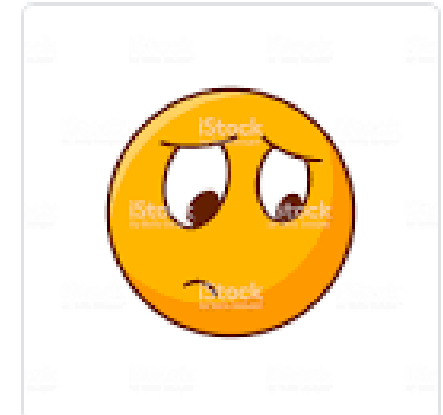


**NDT**



**Why is  
NDT  
so far behind  
other  
markets?**

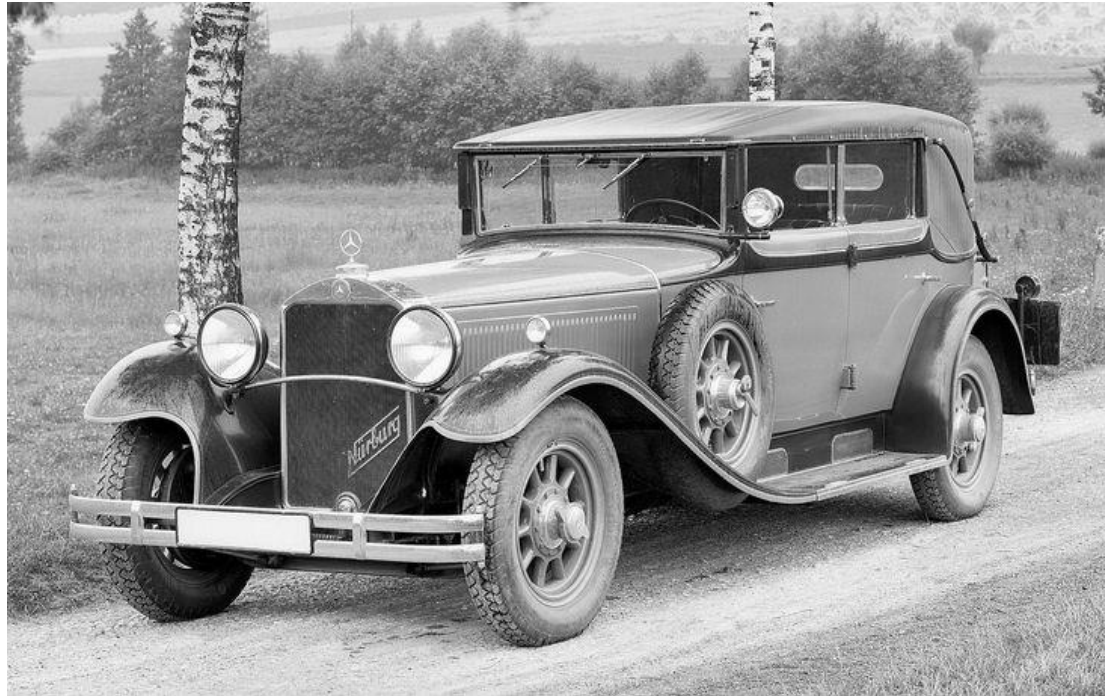
## Digital : Disadvantages



High start-up cost

Not all applications can be covered

and Standard not finalized, but...

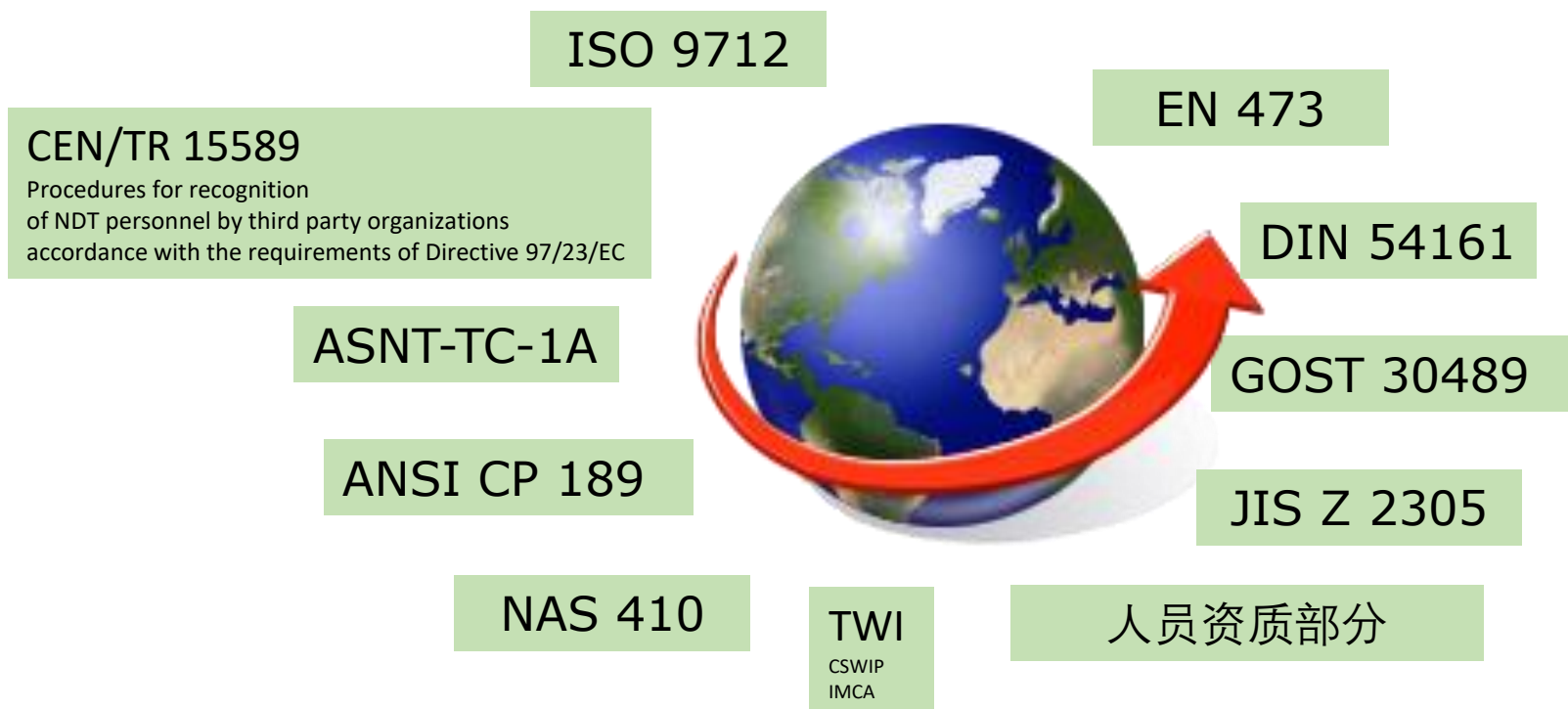


Gottlieb Daimler:

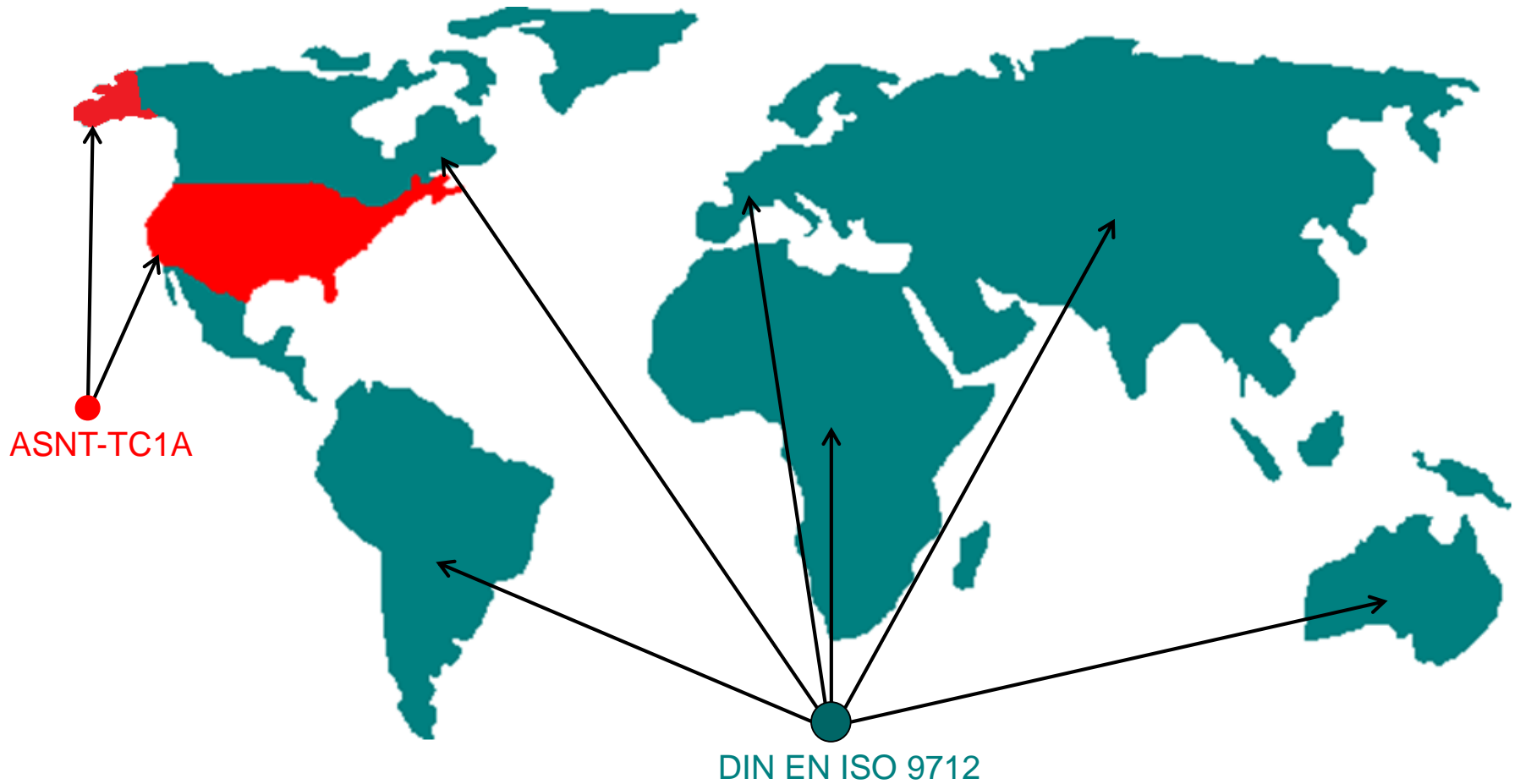
"The worldwide demand for vehicles  
will not exceed one million -  
for lack of **chauffeurs** "



# What is there in the world of the qualification of NDT personnel?



# Scope of the ISO 9712





- Qualification and certification  
of NDT personnel

Revised            EN 473

matches with

**ISO 9712**

Small differences for training and practice  
periods, but significant other requirements for re-certifying

## ISO 9712: Methods

NDT Methods	Acronyms
Acoustic Emission Testing	AT
Electromagnetic Testing	ET
Infrared Thermography Testing	TT
Leak Testing	LT
Magnetic Particle Testing	MT
Penetrant Testing	PT
<b>Radiography Testing</b>	<b>RT</b>
Strain Gauges Measurement	ST
Ultrasonic Testing	UT
Visual and Optical Testing	VT



# Radiography Testing

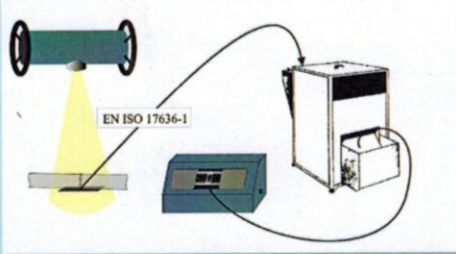
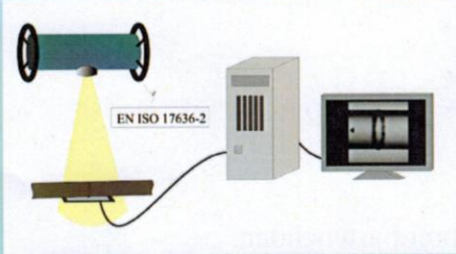

The world of radiography testing has changed !

Standards are available for new applications !

Requirements of NDT service companies have changed!

- More detailed training
  - Certification
  - Consideration of existing qualifications
-

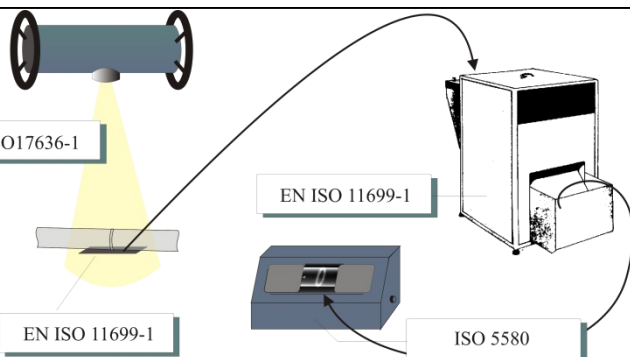
# Dealing with digital detectors requires a new training structure for the range of radiography testing

Rearrangement	Old Course Title	Term from 2015
	RT	RT-F F = Film
		RT-D D = Digital (digital film replacement)
	DR	RT-S S = Scopy



## Radiography Interpretation of weld inspection

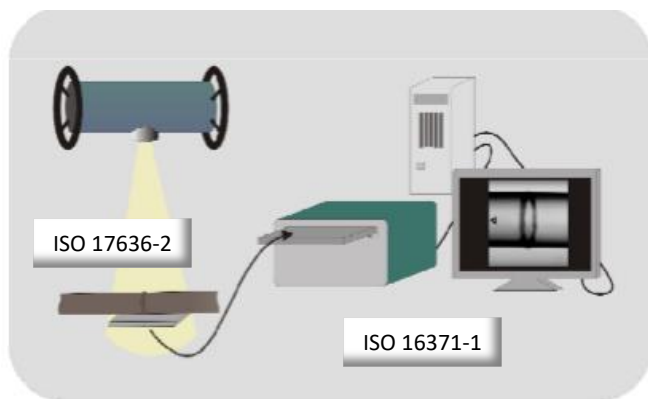
RT - FDI



## Radiography RT



RT - F



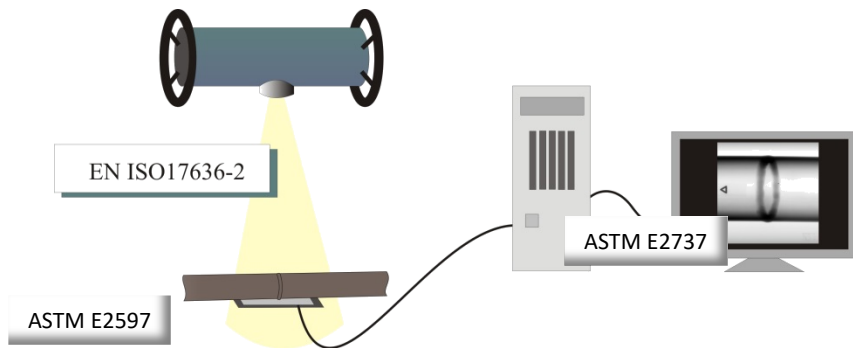
## Digital Film Replacement

by storage image plates



RT - D

Actual designation of RT training

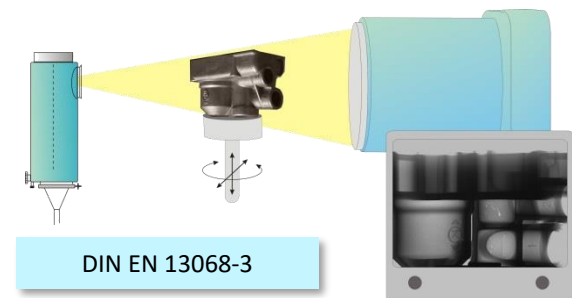


## Digital Film Replacement

by matrix detectors DDAs



RT - D

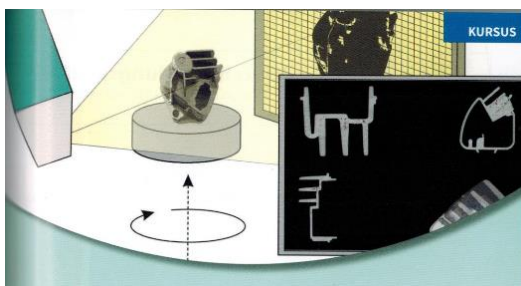


## Radioscopy DR



RT - S

**History**  
RS1/2 1994-2003  
DR1/2 2004-2015



## Computertomography

**NEW**



RT - CT

ISO 15708

Actual designation of RT training



## What are the main changes?


A brief overview:

- The training times for level 1 in surface testing (MT, PT, VT) will be extended from two to three days.  
At the same time, the training time for level 2 is reduced to two days. For the combined courses level 1/2, however, the total remains at 5 days.
- In some procedures, the number of examination questions in the special part of the examination is increased.  
In the practical examination, fewer items will be required in future. The preparation of the examination instructions in level 2 will become a separate part of the examination.

## What are the main changes?

- Employers must describe the subject of NDT personnel in a quality document, keep records and update them annually.
- The required amount of experience time has been reduced.
- A test of colour vision is required every 5 years.
- The renewal will in many cases involve a practical test, as the use of the new credit system will be burdensome and disproportionately expensive.
- Other minor technical and editorial changes.

www.dgzfp.de/RT  
 Record of vision tests  
 and more details about  
 the different Training

 DEUTSCHE GESELLSCHAFT FÜR ZERSTÖRUNGSFREIE PRÜFUNG E.V. PERSONALZERTIFIZIERUNGSTELLE (DPZ)		2.1 Allgemeine Anforderungen   <i>general requirements</i> <b>Sehfähigkeitsbescheinigung</b> <b>Record of vision tests</b>		FBL 2.1.1.1 Rev. 02.0 2014-11-12 Seite   Page 1 von   of 1
Siehe   refer to DIN EN ISO 9712:2012-12, 7.4   DIN EN 13018:2001-07, 7c   DIN EN ISO 8596:2009-10				
Name, Vorname   <i>Name, Surname:</i>		Geburtsstag   <i>Date of birth:</i>		
<b>1. Sehfähigkeit (Nah)</b> (Nahvisus in 30 – 40 cm Abstand, Prüfung jährlich) <b>1. Near vision</b> ( <i>near-vision acuity at a distance of 30 – 40 cm, annual test</i> )				
<input type="checkbox"/> Prüfung mit Jaeger Nr. 1 Buchstaben <i>Examination with Jaeger-No-1-Letters</i>		<input type="checkbox"/> Prüfung mit Landolt-Ringen <i>Examination with Landolt rings</i>		
<input type="checkbox"/> Ja, Visus 1,0 erfüllt <i>yes, visual acuity grade 1.0</i>		<input type="checkbox"/> mit: <i>with:</i>		
<input type="checkbox"/> wenigstens auf einem Auge erreicht <i>visual acuity target met on 1 eye</i>		<input type="checkbox"/> Nein, abweichender Wert: <i>No, visual acuity grade less than 1.0</i>		
		Sehhilfe notwendig: <i>Corrective lenses required:</i>		
		<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>		
<b>2. Farbsehvermögen und Graustufenerkennung   Colour perception and colour differentiation</b>				
<b>2.1 Farbsehvermögen   Colour perception</b>				
Vom Arbeitgeber oder Beauftragten des Arbeitgebers auszufüllen und ggf. Anforderungen des Arbeitgebers beifügen: <i>To be completed by the employer or his representative/ possible requirements of the employer are to be attached:</i>				
Farbsehvermögen erstmalig geprüft am: <i>First date of a colour vision test:</i>		Weitere Prüfung notwendig: <i>Further test required:</i>		
<input type="checkbox"/> Prüfung nach Ishihara <i>Ishihara test</i>		<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>		
<input type="checkbox"/> oder nach: <i>other test:</i>				
Das Farbsehvermögen ist ausreichend: <i>Colour vision is sufficient:</i>		Bemerkung: <i>Remarks:</i>		
<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>				
<b>2.2 Graustufenerkennung   Shades of grey detection / colour differentiation</b>				
Vom Arbeitgeber oder Beauftragten des Arbeitgebers auszufüllen: <i>To be completed by the employer or his representative</i>				
<input type="checkbox"/> muss geprüft werden (RT/Filmauswertung) <i>to be examined (RT)</i>		Prüfung notwendig: <i>Examination required:</i>		
		<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>		
Methode zur Überprüfung der Graustufenerkennbarkeit und Ergebnis: <i>Used colour differentiation test method and result:</i>				
_____				
<b>3. Sehfähigkeit (Fern)</b> (Abstand > 4,0 m)   <i>Far vision (Distance &gt; 4,0 m)</i>				
Vom Arbeitgeber oder Beauftragten des Arbeitgebers auszufüllen: <i>To be completed by the employer or his representative</i>				
<input type="checkbox"/> muss geprüft werden (VT, EN 13018) <i>to be examined</i>		Prüfung notwendig: <i>Examination required:</i>		
		<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>		
<input type="checkbox"/> Prüfung mit Landolt-Ringen <i>Examination with Landolt rings</i>		<input type="checkbox"/> mit: <i>with:</i>		
<input type="checkbox"/> Ja, Wert $\geq 0,63$ erfüllt <i>Visual acuity grade 0.63 or more</i>		<input type="checkbox"/> Nein, abweichender Wert: <i>No, visual acuity grade less than 0.63</i>		
<input type="checkbox"/> wenigstens auf einem Auge erreicht <i>visual acuity target met on 1 eye</i>		Sehhilfe notwendig: <i>Corrective lenses required:</i>		
		<input type="checkbox"/> ja, <input type="checkbox"/> nein <i>yes, no</i>		
Date der Untersuchung: <i>Date of examination:</i>	Stempel: <i>Stamp:</i>	Name: <i>Name:</i>	Unterschrift: <i>Signature:</i>	



## Summarized: 5 Steps to Certification:



### 1. Training

according to the requirements of DIN EN ISO 9712 and certification program



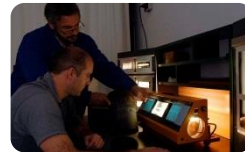
### 2. Qualification Test (examination)

must be passed in each part with at least 70%



### 3. Industrial NDT experience

must be sufficient according to DIN EN ISO 9712



### 4. Vision Test

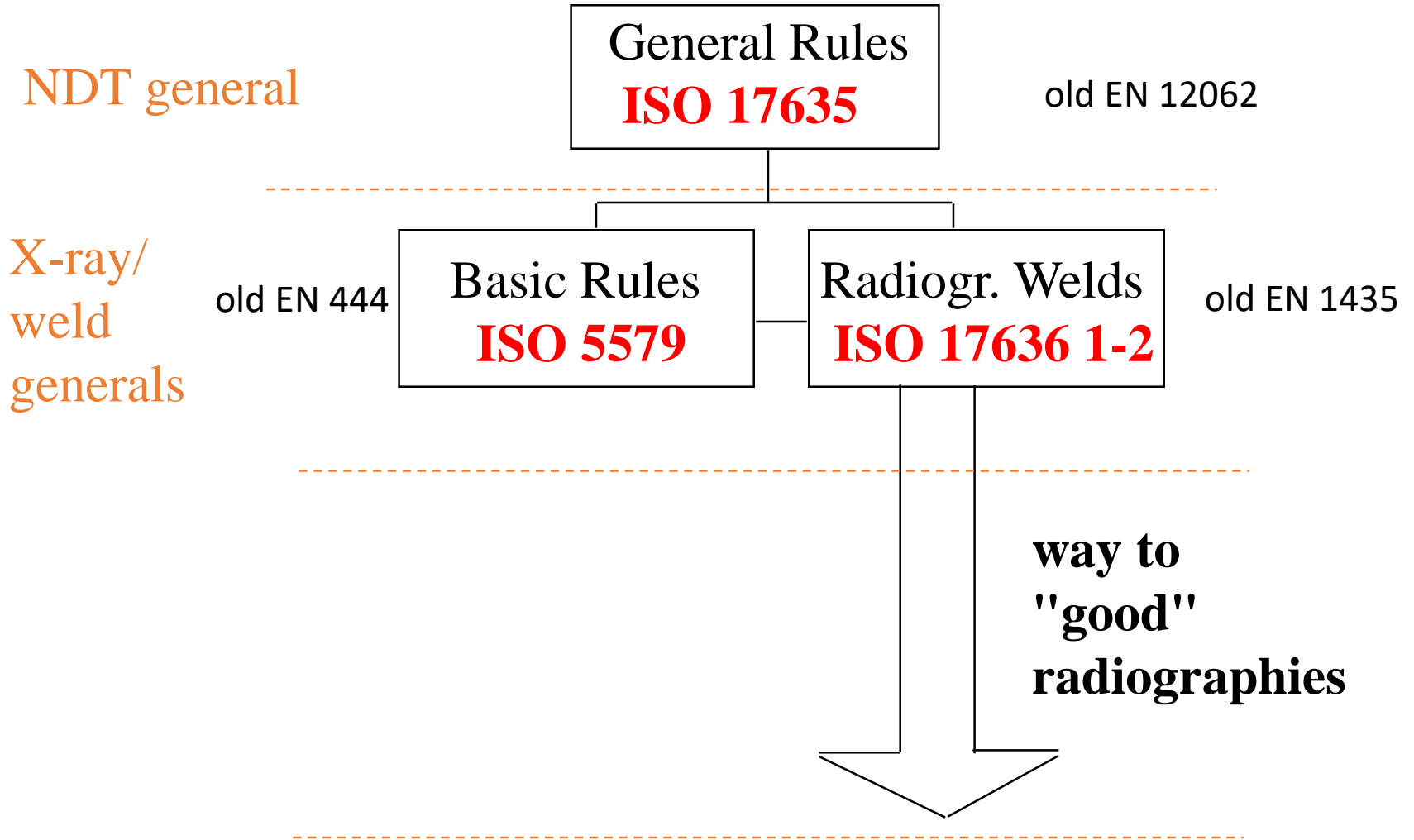
must be proven annually



### 5. Application for certification

(within 2 years if all requirements are fulfilled)

# Weld Inspection



## Revision of the **ISO 17636**

### RT-Practice for Welding

- 17636-1:2022      Film
- 17636-2:2022      CR and DDAs

# Weld Inspection

characterization of  
industrial film  
systems &  
illuminator

Radiogr. Film  
**ISO11699, 1-2**

old EN 584, 1-2

Illuminators  
**ISO 5580**

old EN 25580

image quality  
indicators

IQI's  
**ISO 19232, 1-5**

old EN 462, 1-5

way to  
"good"  
radiographies

# ISO 19232, 1-5

## Part 1: Wire IQI



## Part 2: Step-Hole IQI

Part 3: Image Quality Classes

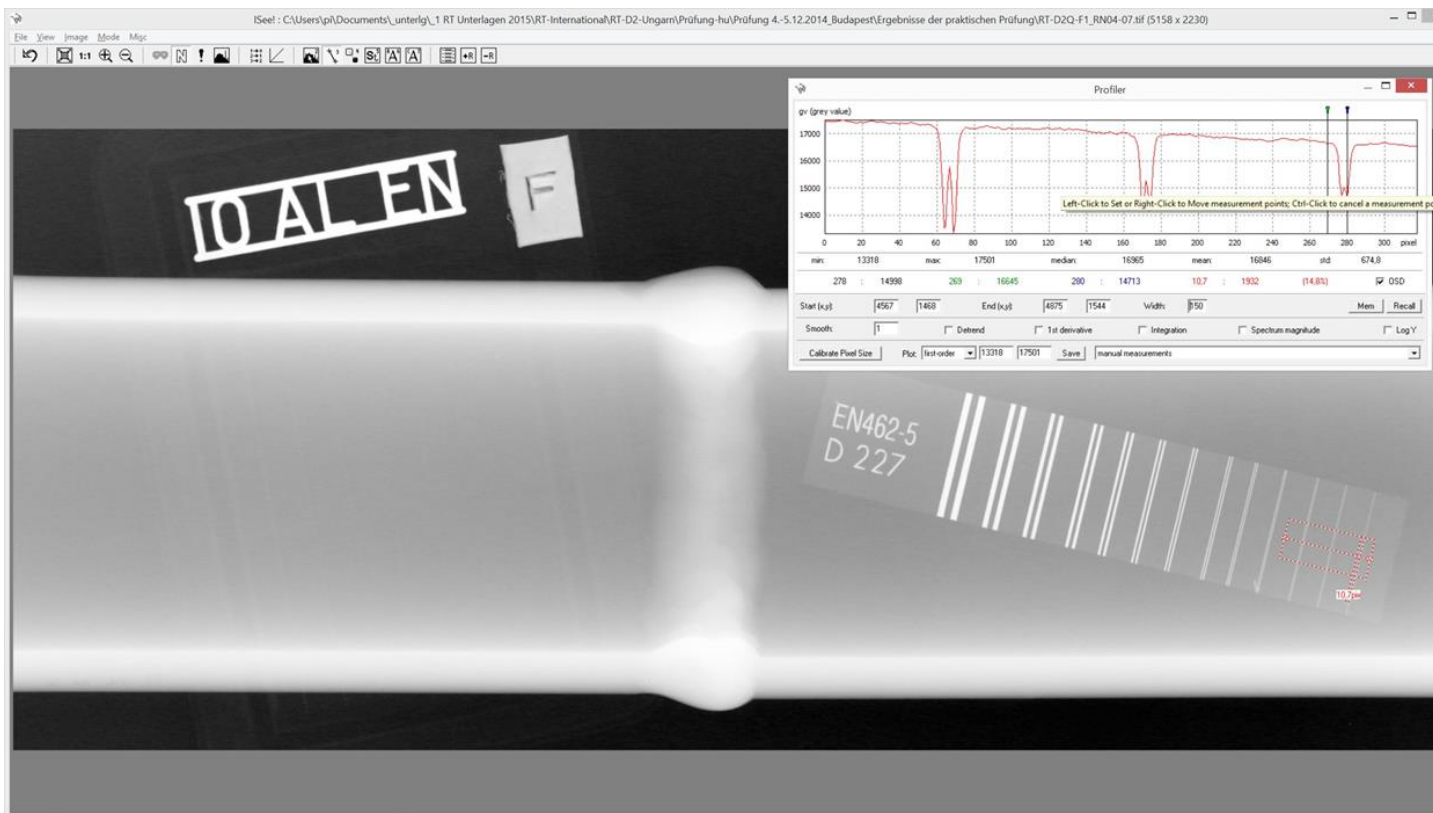
Part 4: Experimental Evaluation of  
Image Quality classes

## Part 5: Duplex Wire IQI



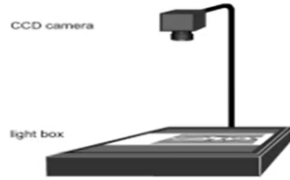


## Products – X-Ray Accessories – Digital Technique



Evaluation of Duplex wire type IQI

## • Digital Radiography – Radioscopy



### ISO 14096

Classification of Film Digitizers  
in class DA, DB, DS



### ISO 16371, 1-2

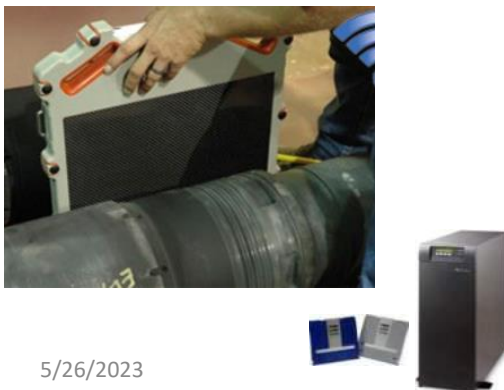
- Industrial computed radiography with storage phosphor imaging plates
- Part 1: Classification of systems
- Part 2: General principles for testing of metallic materials using X-rays and gamma rays

### ISO 17636-2

Non-destructive testing of welds - Radiographic testing  
-Part 2: X- and gamma-ray techniques with **digital detectors**

### ASTM E 2445-05

Standard Practice for Classification of  
**Computed Radiography Systems**



**ISO 17636-2**, see above

### ASTM E2737

Standard Practice for  
**Digital Detector Array Performance  
Evaluation and Long-Term Stability**

How to get Digital Images ?

## Film Scanner

### FS

#### **EN 14096 - Classification of Film Digitizers :**

- **Class DA** : basic performance, reduced resolution
- **Class DB** : enhanced performance with some reduction of Image Quality
- **Class DS** : enhanced performance with insignificant reduction of Image Quality

How to get Digital Images ?

# Phosphor Scanner Systems CR

**European Standard: EN 14784 now ISO 16371**

**Industrial computed radiography with  
phosphor imaging plates**

**Part 1 Classification of systems**

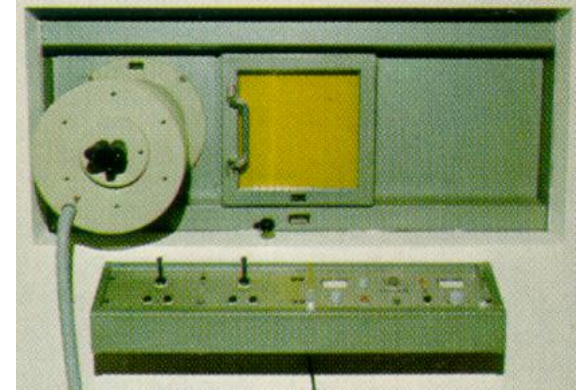
**Part 2 General Principles**

## Radioscopic Inspection

Common Standard:

Radioscopic testing: **EN 13068**

- Part I: Quantitative measurement of imaging properties
- Part II: Qualitative control and long term stability of imaging devices
- Part III: General principles of radioscopic testing of construction materials by X- and Gamma rays

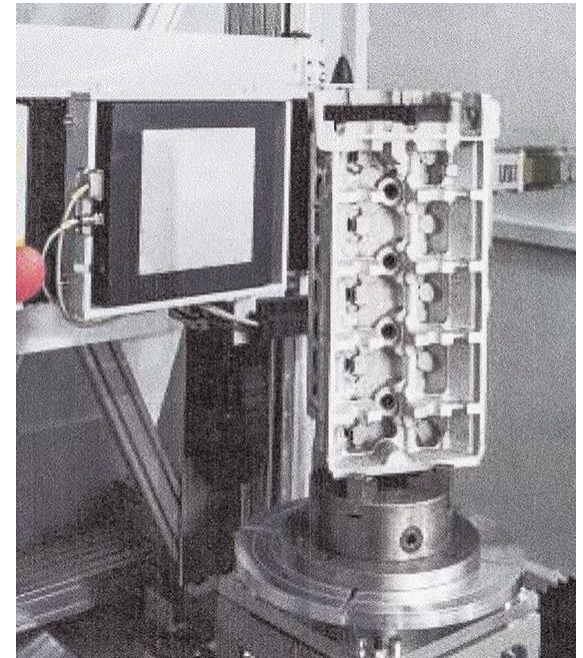


Today additionally important

X-Ray Flat Panel detectors  
DDAs (Digital Detector Arrays)

- **ASTM E 2597**  
Standard Practice for  
Manufacturing Characterisation
- **ASTM E 2737**  
Performance Evaluation Long-Term-Stability
- **Application specific standards**

## Radioscopic Inspection





## Cast Inspection

### **EN 12681-1:2017**

Founding - Radiographic testing - Part 1: Film techniques

### **EN 12681-2:2018-02**

**Founding - Radiographic testing - Part 2:  
Techniques with digital detectors;**



- New testing classes for digital Radiography
  - Class A<sub>A</sub>: basic automated techniques.
  - Class B<sub>A</sub>: improved automated techniques.
  - Perform the testing according to class A or A<sub>A</sub>, if not otherwise specified in the order.
- 

New image quality requirements in class A and B:

Classes A<sub>A</sub> and B<sub>A</sub> are requirements for automated and semi-automated radiographic testing using DDAs and Computer or Operator based image evaluation, and mini or micro focus X-ray tubes (focal spot  $\leq 1$  mm) with reduced requirements for unsharpness at equal contrast sensitivity.



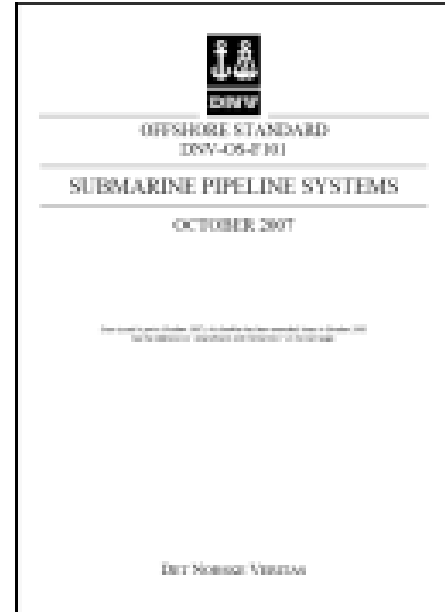
# X-Ray Inspection in Pipe Mills

*API 5L, DNV-OS-F101,  
ISO 12096*            *ISO 10893*

## Application:

Inspection of welding seams on  
new pipes in production:

- Longitudinal welding seams
- Spiral welding seams
- Pipe-ends



## Computed Tomography

**ISO 15708:2017 substitutes EN 16016-1 to -4 in 2018/2019**

- **EN 16016-1 to -4 to be deleted!**

**Revision of ASTM Guide E 1441**

- Standard Guide for Computed Tomography (CT) Imaging

**Revision of ASTM Practice E 1695**

- Test Method for Measurement of Computed Tomography (CT) System Performance

## Metrology

**ISO TC 213** new draft for dimensional measurement,

see also **Vdi/VdE – standards 2630 Part 1 - 4**


To discuss topics in the X-Ray Forum visit

 <https://www.x-ray-forum.net>

Example:







**Köszönöm,  
hogy  
meghallgattak**