AIGA 2007 MEETING

PACKAGED GASES SAFETY

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PATTAYA, THAILAND

Asia Industrial Gases Association

ISO CYLINDERS
RE-QUALIFICATION AND USE

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AIR LIQUIDE – Paris (France)

INTRODUCTION

1. Structure of ISO/TC 58
2. P and O Members
3. List of standards

- ✓ Periodic inspection
- ✓ Pre-fill inspection
- ✓ Identification of cylinders
- ✓ Bundles and trailers
- ✓ Other standards

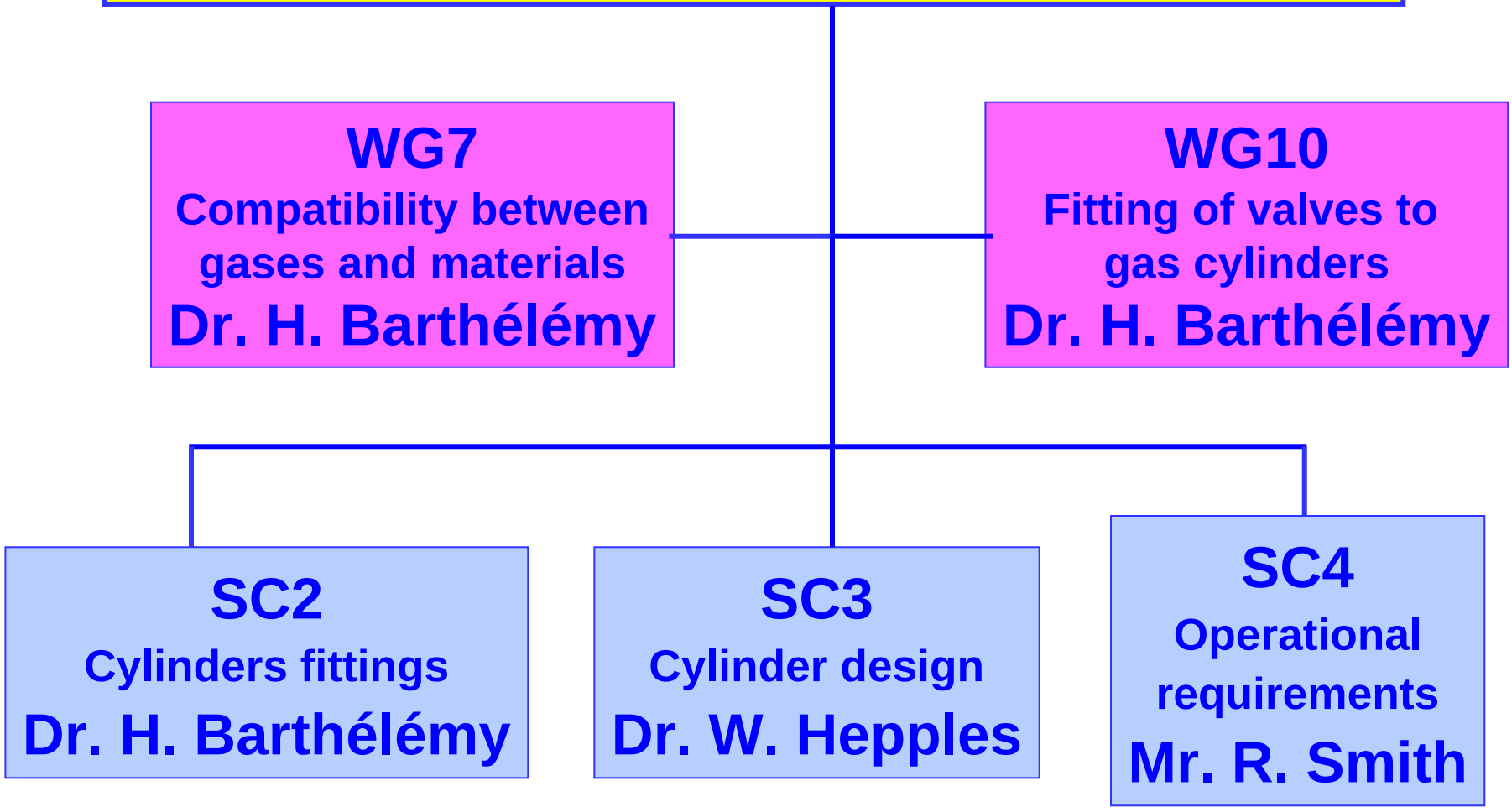
INTRODUCTION

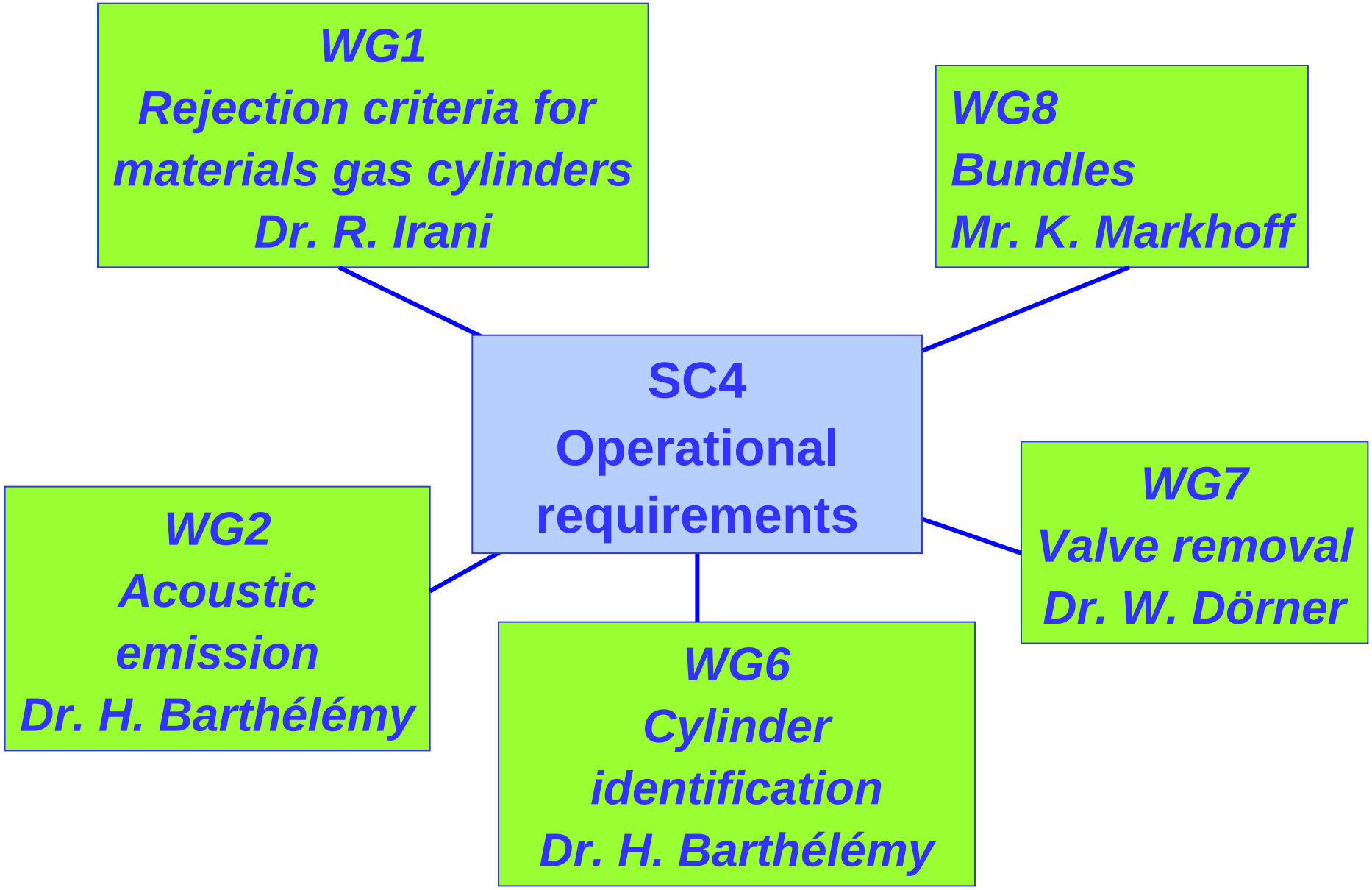
4. Other methods (hydrotest – UT – AE)

5. Work to identify the acceptance criteria for defects

6. Conclusions

1. STRUCTURE ISO/TC 58 – Gas cylinders
Dr. C. Jubb




WG1
Rejection criteria for materials gas cylinders
Dr. R. Irani
WG8
Bundles
Mr. K. Markhoff
SC4
Operational requirements
WG2
Acoustic emission
Dr. H. Barthélémy
WG7
Valve removal
Dr. W. Dörner
WG6
Cylinder identification
Dr. H. Barthélémy

2. P AND O MEMBERS

P	O	MEMBER BODY	P	O	MEMBER BODY
X		AUSTRALIA (SA)		X	ECUADOR (INEN)
X		AUSTRIA (ON)	X		FINLAND (SFS)
X		BELGIUM (NBN)	X		FRANCE (AFNOR)
	X	BRAZIL(ABNT)	X		GERMANY (DIN)
X		CANADA (SCC)		X	HUNGARY (MSZT)
	X	CHILE (INN)	X		INDIA (BIS)
X		CHINA (SAC)	X		IRAN, ISLAMIC REPUBLIC OF (ISIRI)
X		COLOMBIA (ICONTEC)	X		IRELAND (NSAI)
	X	CZECH REPUBLIC (CNI)			

P	O	MEMBER BODY	P	O	MEMBER BODY
X		ITALY (UNI)	X		SOUTH AFRICA (SABS)
X		JAPAN (JISC)	X		SPAIN (AENOR)
	X	KENYA (KEBS)	X		SWEDEN (SIS)
X		KOREA, REPUBLIC OF (KATS)	X		SWITZERLAND (SNV)
	X	NETHERLANDS (NEN		X	TURKEY (TSE)
	X	POLAND (PKN)	X		UNITED KINGDOM (BSI)
X		PORTUGAL (IPQ)		X	URUGUAY (UNIT)
X		ROMANIA (ASRO)	X		USA (ANSI)

3. LIST OF CYLINDER STANDARDS

PERIODIC INSPECTION

ISO 6406 : 2005	Seamless steel
ISO 10460 : 2005	Welded carbon-steel
ISO 10461 : 2005 and AMD1 : 2006	Seamless aluminium alloy
ISO 10462 : 2005	Transportable cylinders for dissolved acetylene
ISO 10464 : 2004	Refillable welded steel cylinders for liquefied petroleum gas (LPG)

3. LIST OF CYLINDER STANDARDS

PERIODIC INSPECTION

ISO 16623 : 2002	Composite gas cylinders
ISO 16148 : 2006	Refillable seamless steel gas cylinders – Acoustic emission testing (AT)
ISO 19078 : 2006	Inspection of the cylinder installation, and requalification of high pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

3. LIST OF CYLINDER STANDARDS

PREFILL INSPECTION

ISO 10691 : 2004	Refillable welded steel liquefied petroleum gas (LPG)
ISO 11372 : 2005	Dissolved acetylene
ISO 11622 : 2005	Conditions for filling gas cylinders
ISO 11755 : 2005	Cylinder bundles for compressed and liquefied gases
ISO 24431 : 2006	Compressed and liquefied gases (excluding acetylene)

3. LIST OF CYLINDER STANDARDS

IDENTIFICATION OF CYLINDERS

ISO 13769	Stamp marking
ISO 7225 : 2005	Precautionary labels
ISO 21007 : 2005	Identification and marking using radio frequency identification technology Part 1 : Reference architecture and terminology
	Part 2 : Numbering schemes for radio frequency identification

3. LIST OF CYLINDER STANDARDS

IDENTIFICATION OF CYLINDERS

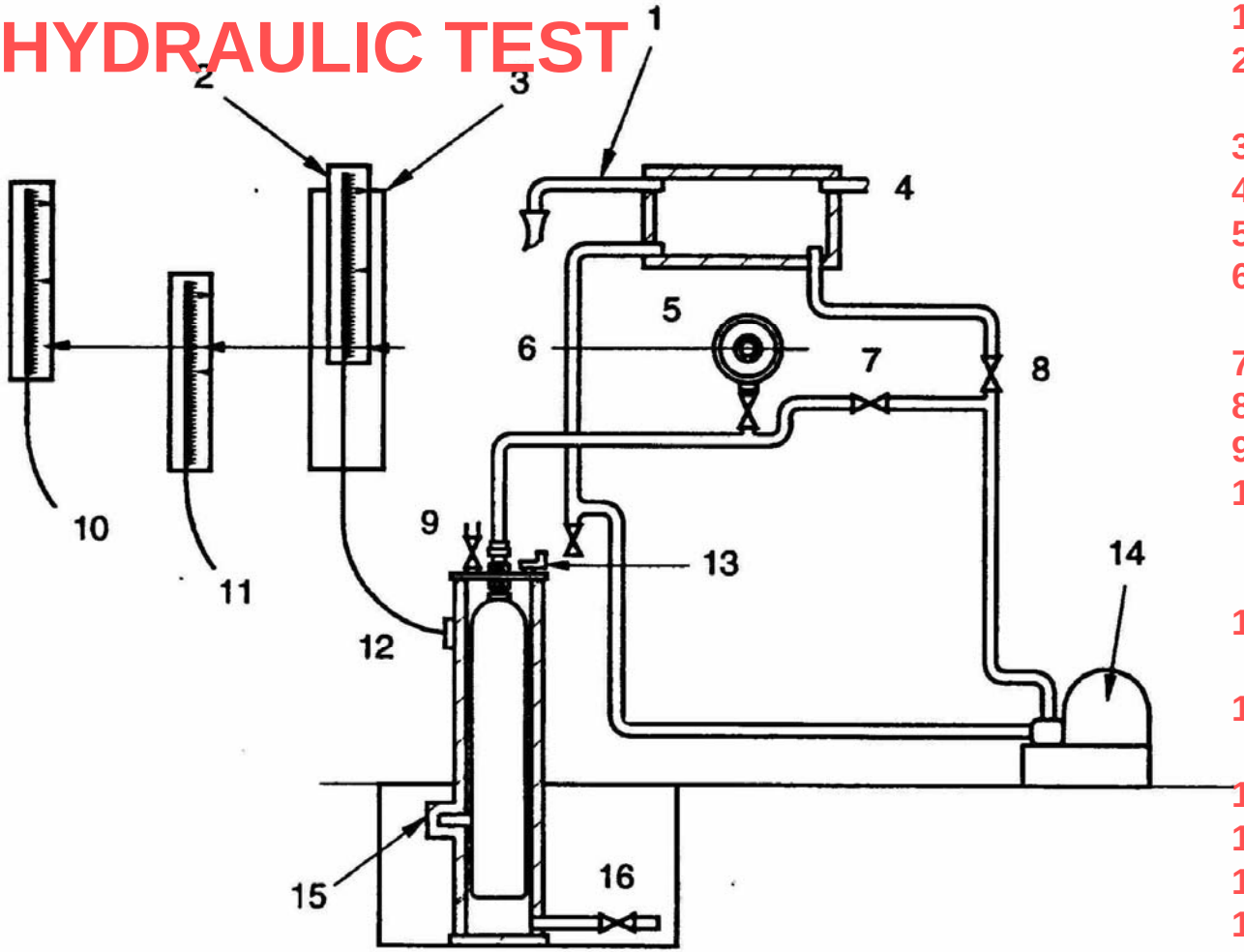
ISO 32	Colour coding
ISO 13769	Stamp marking

OTHER STANDARS

ISO 11621 : 1997	Procedures for change of gas service
ISO 13770 : 1997	Aluminium alloy – Operating requirements for avoidance of neck and shoulder cracks

4. RETEST METHODS

HYDRAULIC TEST



1. Overflow
2. Calibrated burette sliding in fixed frame
3. Fixed frame
4. Water supply
5. Water and eye level
6. Pointer attached to fixed frame at water level
7. Hydraulic line valve
8. Priming valve
9. Jacket filling valve
10. Position when pressure is released; Reading = permanent expansion
11. Position at test pressure; Reading = total expansion
12. Position before pressurization
13. Air-bleed valve
14. Pump
15. Relief device
16. Drain

Water jacket volumetric expansion test (levelling burette method)

4. RETEST METHODS

HYDRAULIC TEST

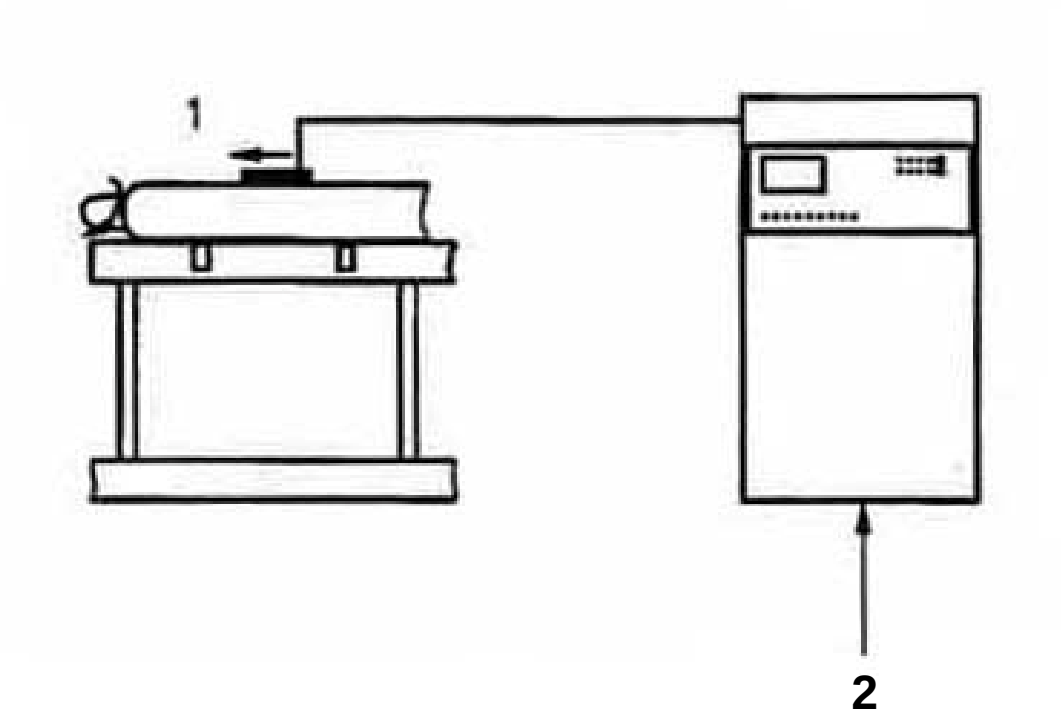
4. RETEST METHODS

HYDRAULIC TEST

Stamp marking

4. RETEST METHODS

ULTRASONIC TEST (UT)

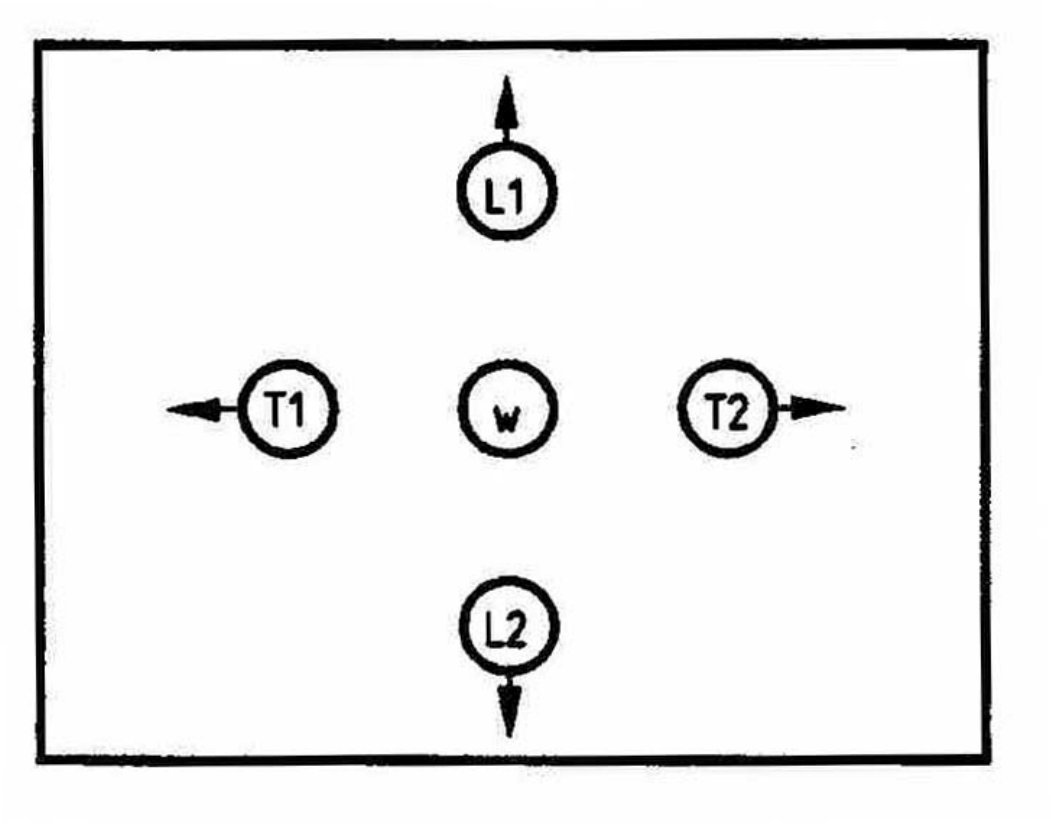


1. UE transducers moving
2. Ultrasonic examination equipment

Type of ultrasonic examination devices for gas cylinders

4. RETEST METHODS

ULTRASONIC TEST (UT)



L1, L2	Longitudinal transducers
T1, T2	Transverse transducers
W	Wall thickness transducer

Example of the arrangement of transducers

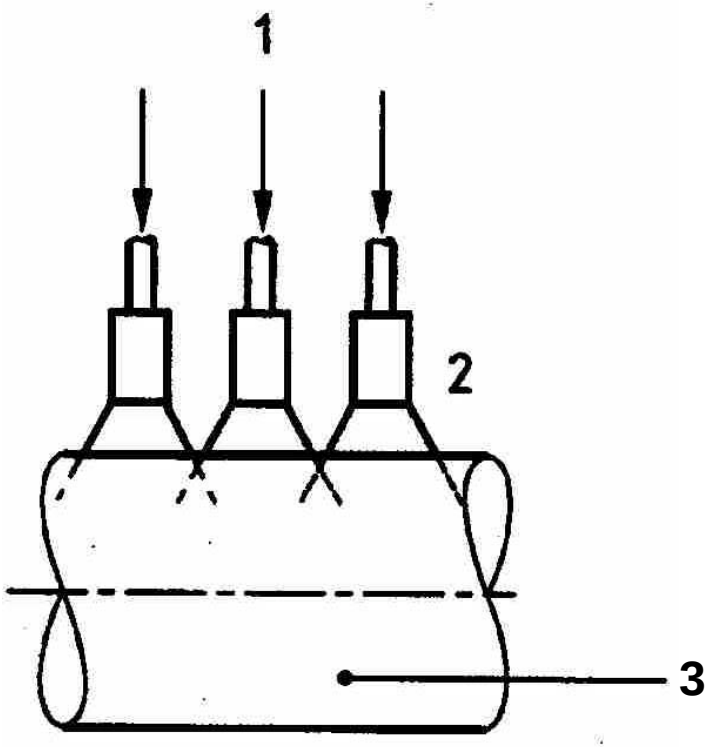
4. RETEST METHODS

ULTRASONIC TEST (UT)

Example of ultrasonic test

4. RETEST METHODS

ULTRASONIC TEST (UT)

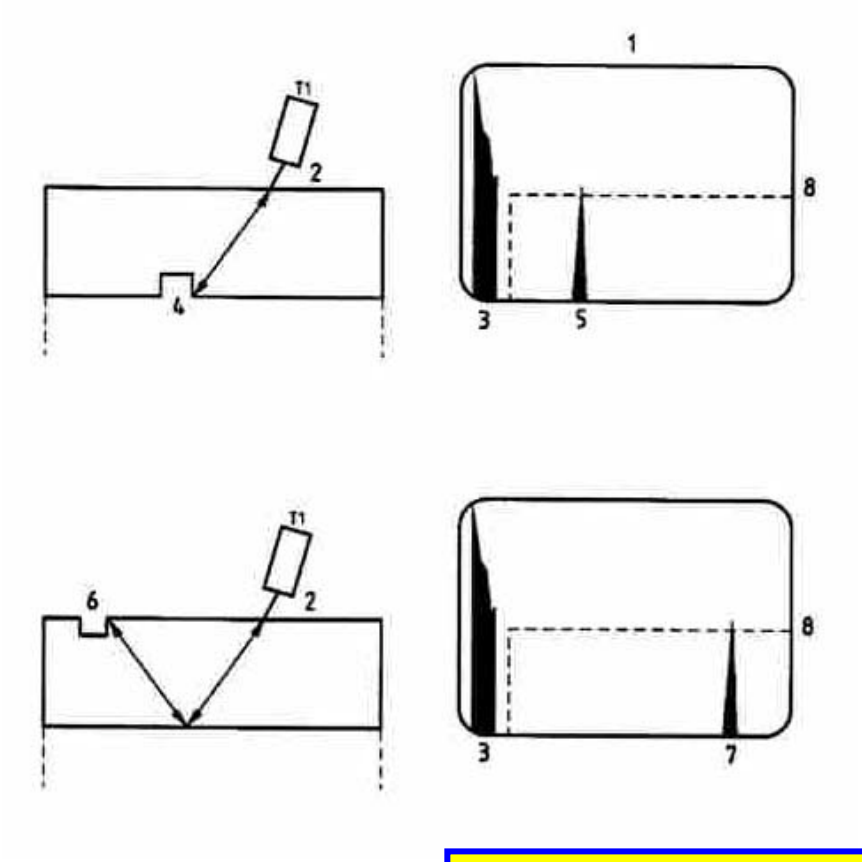


1. Water
2. Transducers
3. Cylinder

Example of coupling techniques

4. RETEST METHODS

ULTRASONIC TEST (UT)

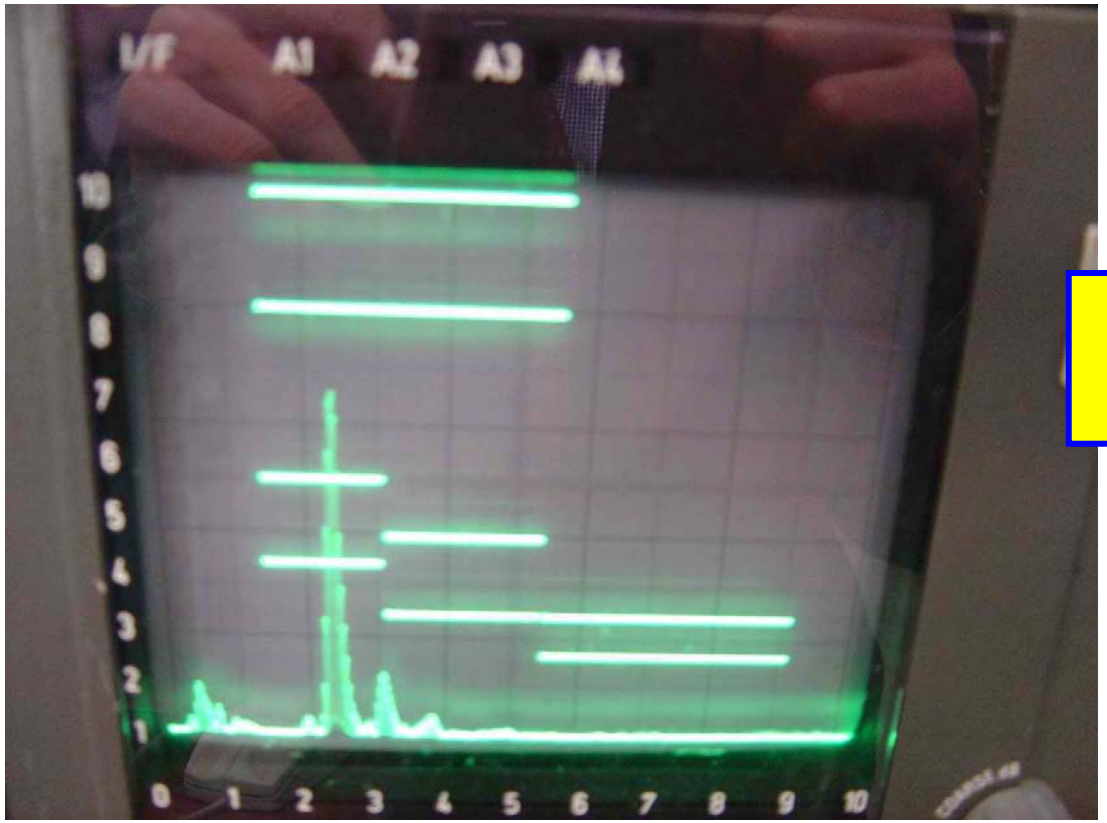


- T1 Transverse transducer
1. Screen
2. Calibration specimen wall
3. UE signal trace from calibration specimen wall
4. Inner reference notch
5. UE signal trace from inner reference notch
6. Outer reference notch
7. UE signal trace from outer reference notch
8. Alarm level

Flaw alarm example

4. RETEST METHODS

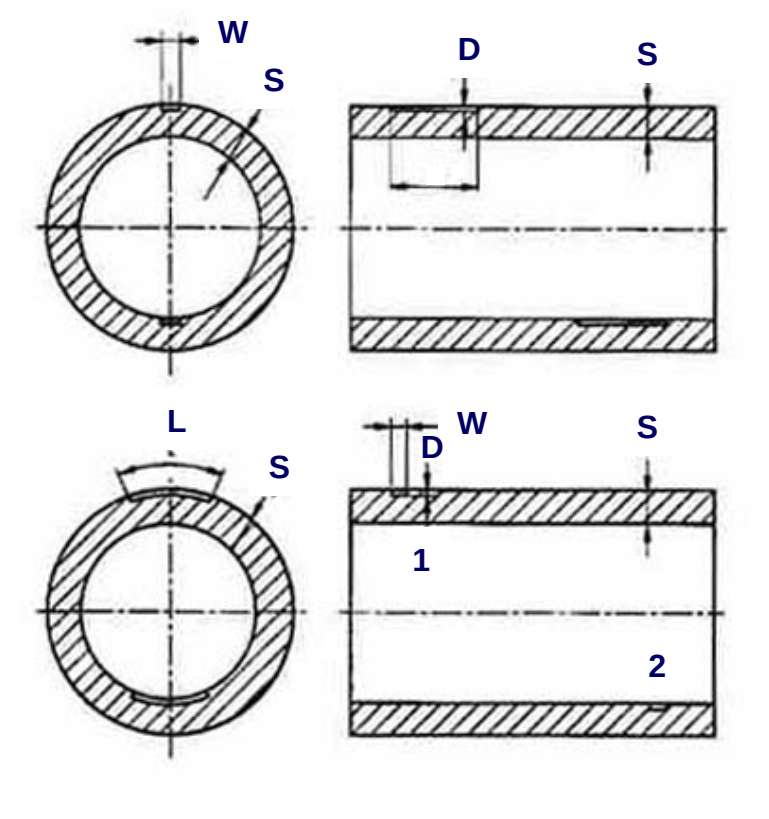
ULTRASONIC TEST (UT)



Example of flaw alarm

4. RETEST METHODS

ULTRASONIC TEST (UT)



1. Outer notch
2. Inner notch

L Length of notches: 50 mm

D Depth of the notches: (5 + 1)% minimum guaranteed wall thickness or 10 % *S*

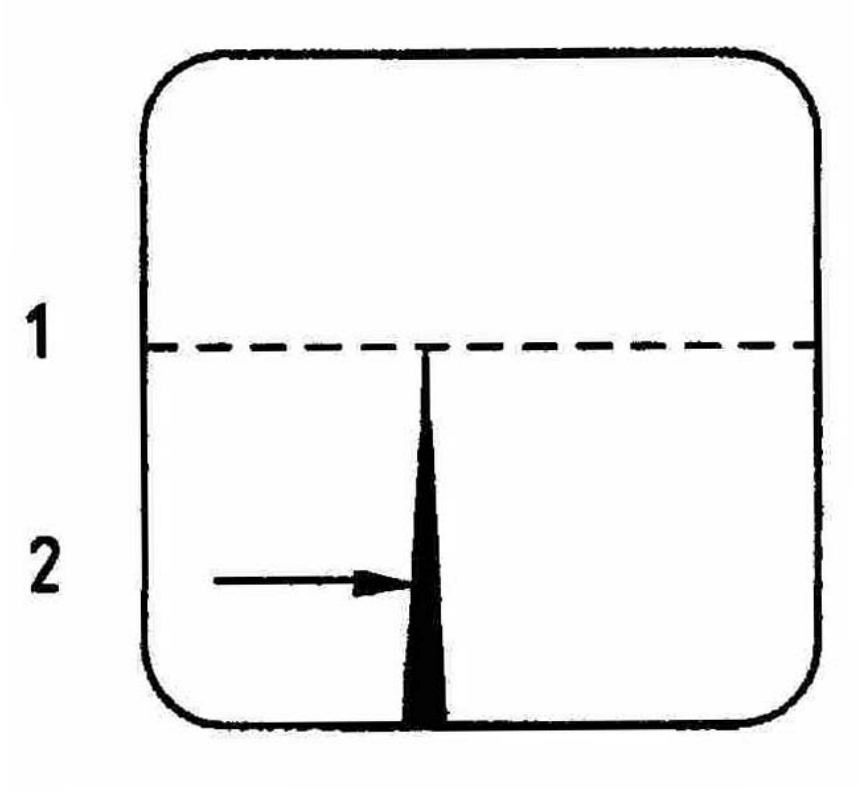
W Width of the notches : < 2*D*

S Actual measured wall thickness

Example of reference notches

4. RETEST METHODS

ULTRASONIC TEST (UT)



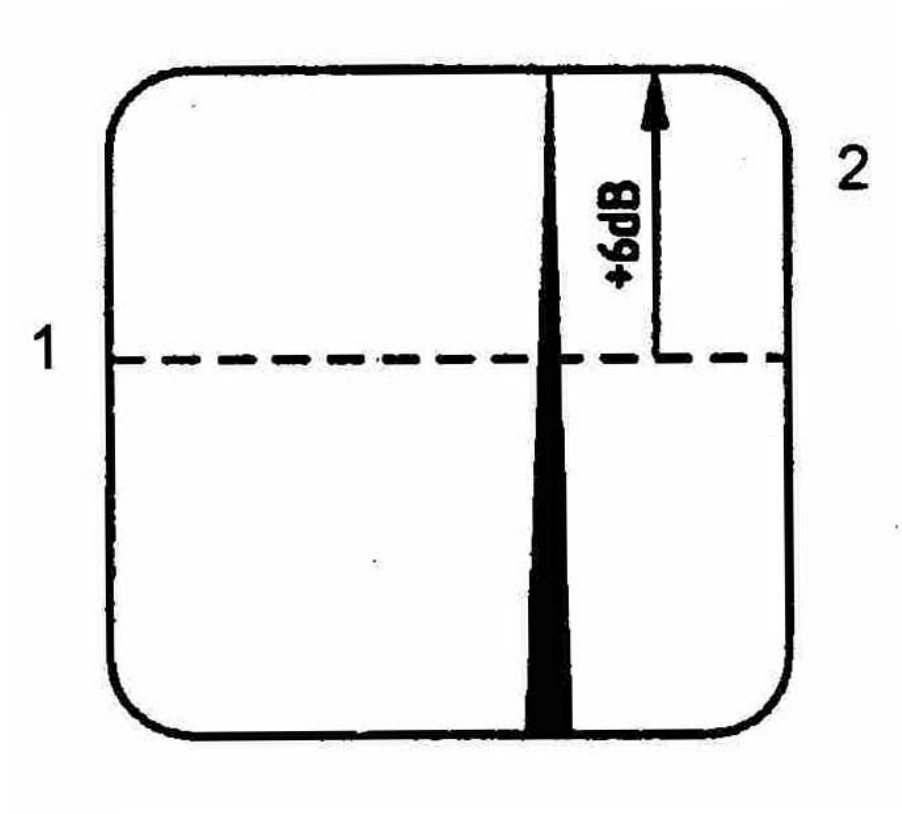
1. Alarm level

2. Signal of reference notch

Reference notch amplitude

4. RETEST METHODS

ULTRASONIC TEST (UT)



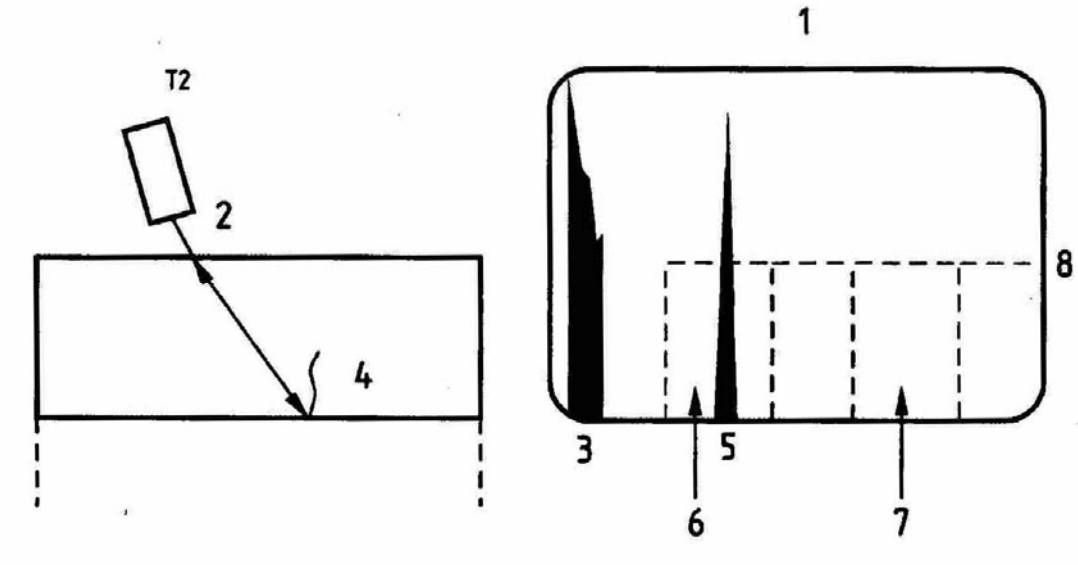
1. Alarm level

2. Signal of adjusted reference notch

Screening test amplitude

4. RETEST METHODS

ULTRASONIC TEST (UT)



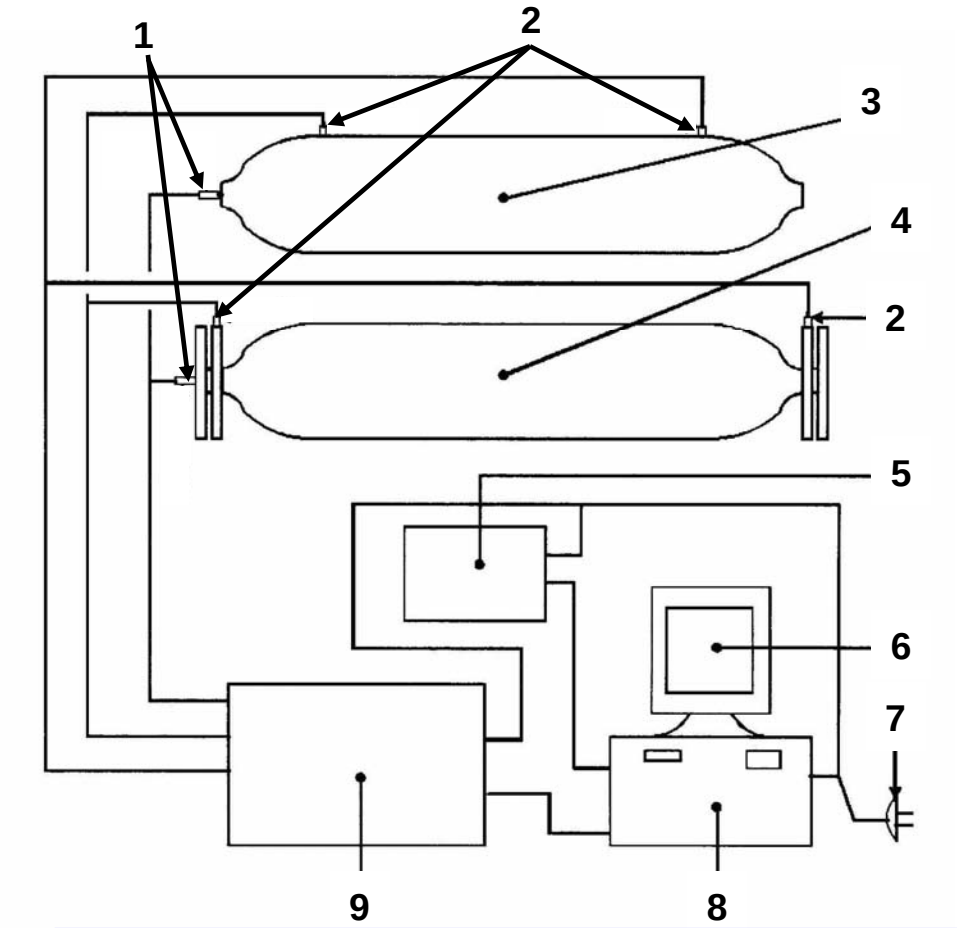
T2 Transverse transducer

1. Screen
2. Cylinder wall
3. UE signal from cylinder wall
4. Crack on internal surface
5. UE signal from crack
6. Region of signals from cracks on internal surface
7. Region of signals from cracks on external surface
8. Alarm level

Detection of crack in transverse direction (example)

4. RETEST METHODS

ACOUSTIC EMISSION



1. Pressure transducer
2. AE sensors with integral preamplifier (2 for each tube)
3. Sensors mounted on sidewall
4. Sensors mounted on end flanges
5. Printer
6. Video monitor
7. Power
8. Computer
9. AE signal processor

Essential features of AE examination equipment

4. RETEST METHODS

ACOUSTIC EMISSION

5. SAFE USE OF GAS CYLINDERS

TYPICAL DEFECTS

- ✓ Bulge
- ✓ Dent
- ✓ Cut or gouge
- ✓ Crack
- ✓ Fire damage
- ✓ Plug or neck inserts
- ✓ Stamping
- ✓ Arc or torch burns
- ✓ Suspicious marks
- ✓ Vertical stability

5. SAFE USE OF GAS CYLINDERS

CORROSION DEFECTS

- ✓ General corrosion
- ✓ Local corrosion
- ✓ Chain pitting or line corrosion
- ✓ Isolated pits
- ✓ Crevice corrosion

5. SAFE USE OF GAS CYLINDERS

EXAMPLE OF DEFECT

Cut or gouge

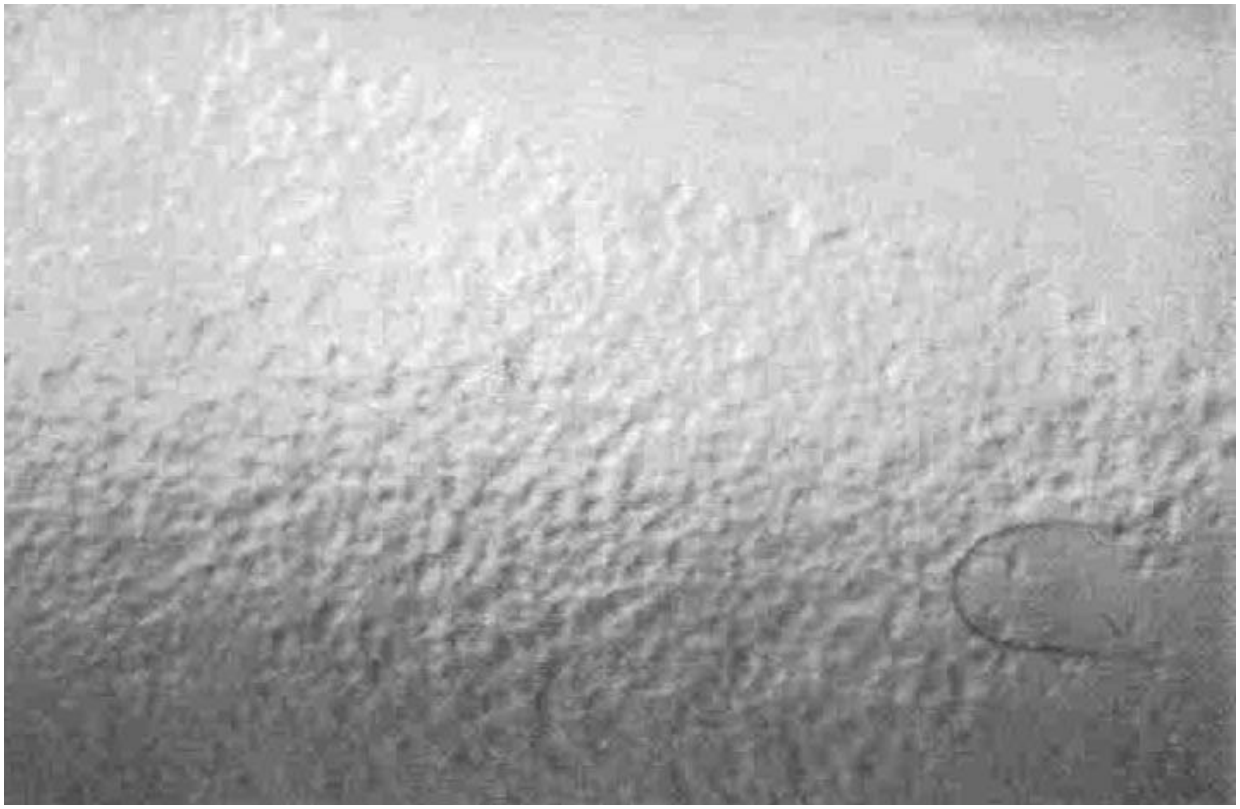
5. SAFE USE OF GAS CYLINDERS

EXAMPLE OF DEFECT

Crack

5. SAFE USE OF GAS CYLINDERS

EXAMPLE OF DEFECT



General corrosion

5. SAFE USE OF GAS CYLINDERS

EXAMPLE OF DEFECT

Channel (line) corrosion

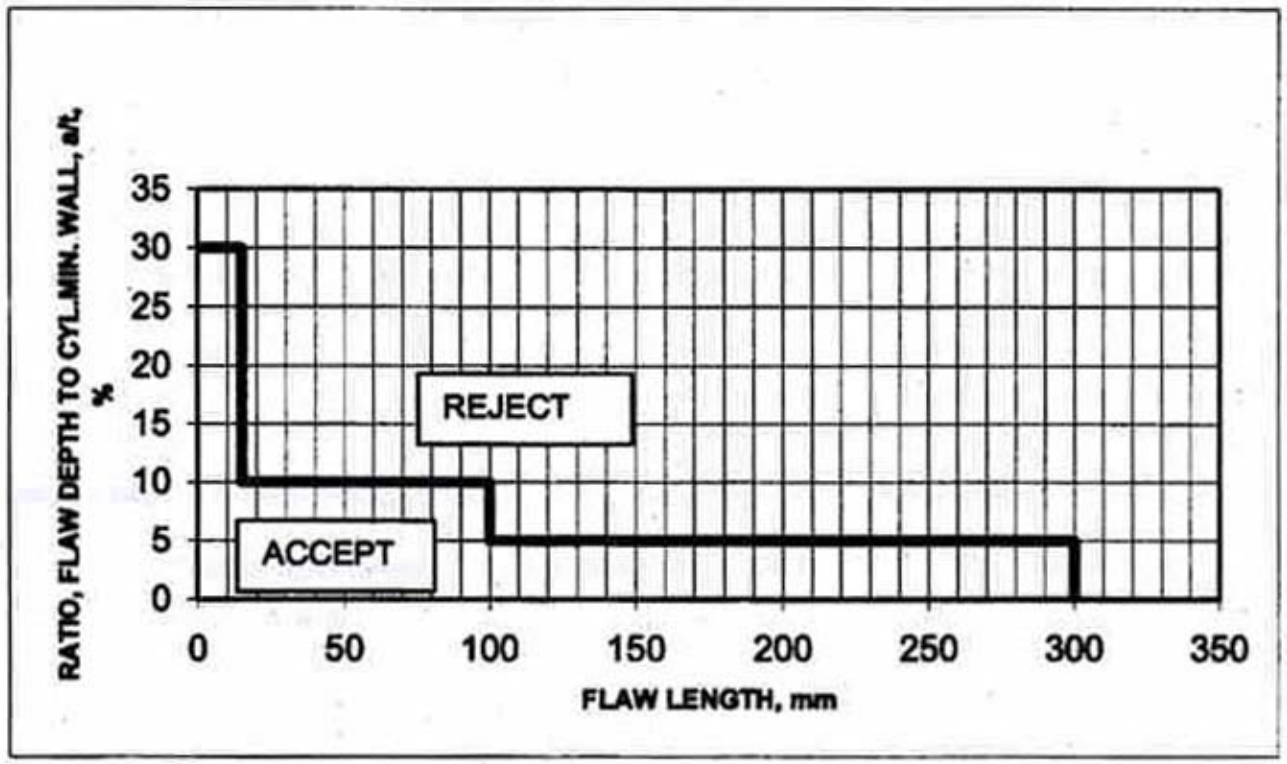
5. SAFE USE OF GAS CYLINDERS

EXAMPLE OF DEFECT

Isolated pits

5. SAFE USE OF GAS CYLINDERS

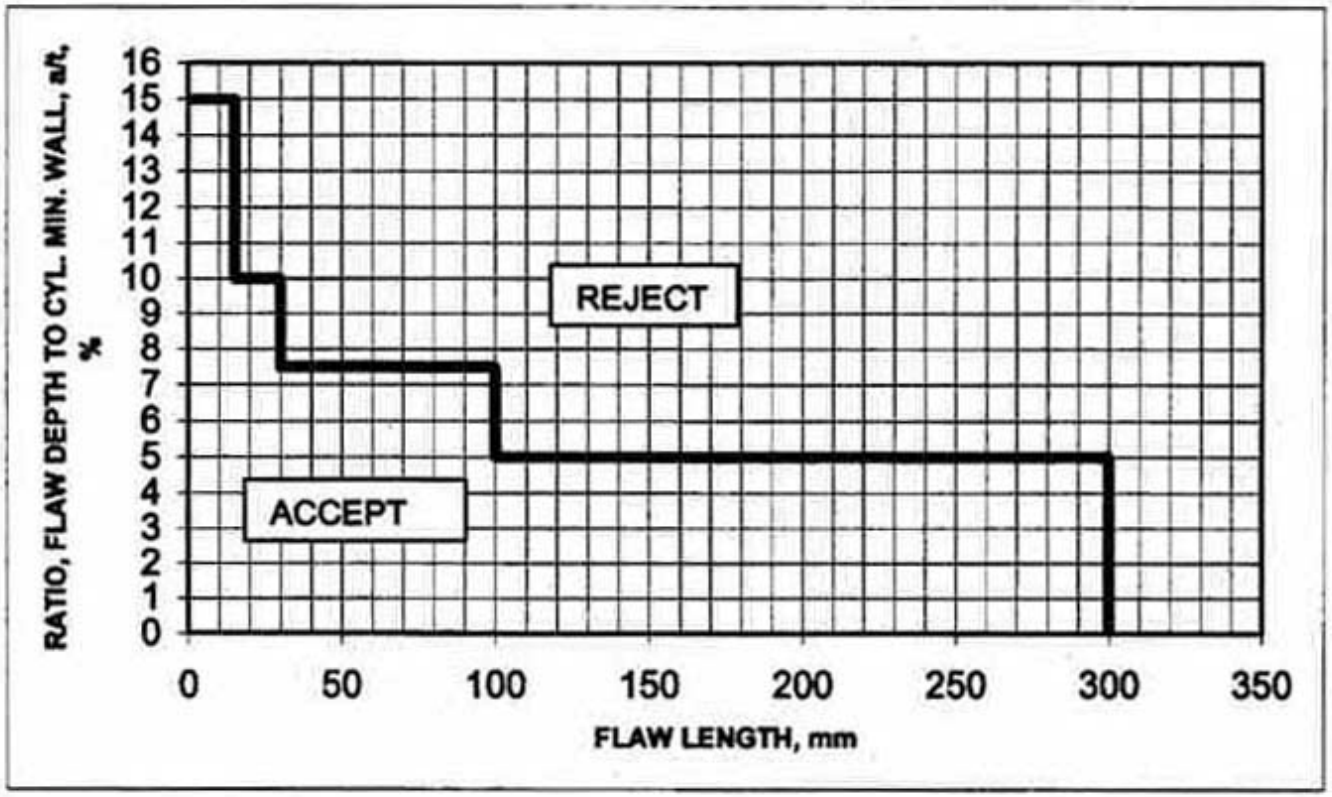
METHOD FOR ACCEPTANCE/REJECTION CRITERIA



LTA acceptance/rejection curve for steel cylinders

5. SAFE USE OF GAS CYLINDERS

METHOD FOR ACCEPTANCE/REJECTION CRITERIA



LTA acceptance/rejection curve for aluminium cylinders

6. CONCLUSIONS

- GOOD ISO STANDARDS ARE AVAILABLE FOR CYLINDER RE-QUALIFICATION AND SAFE USE
- COVER ALL TYPE OF CYLINDERS (SEAMLESS, WELDED, COMPOSITE,…)
- NEW RETEST METHODS ARE SPECIFIED (UT, AE)
- NEW CONCEPTS FOR ACCEPTANCE/ REJECTION CRITERIA ARE PROPOSED