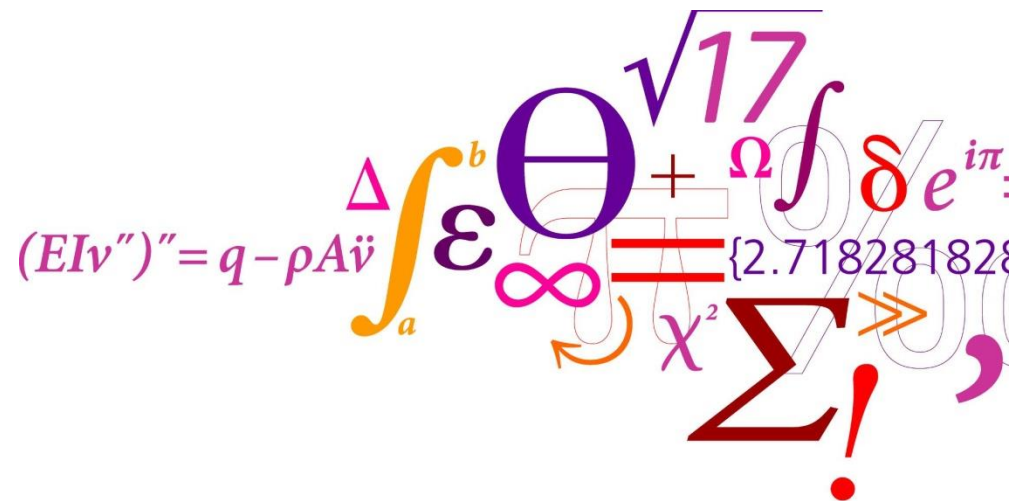


Detection of the onset of galling in strip reduction testing using acoustic emission

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Outline

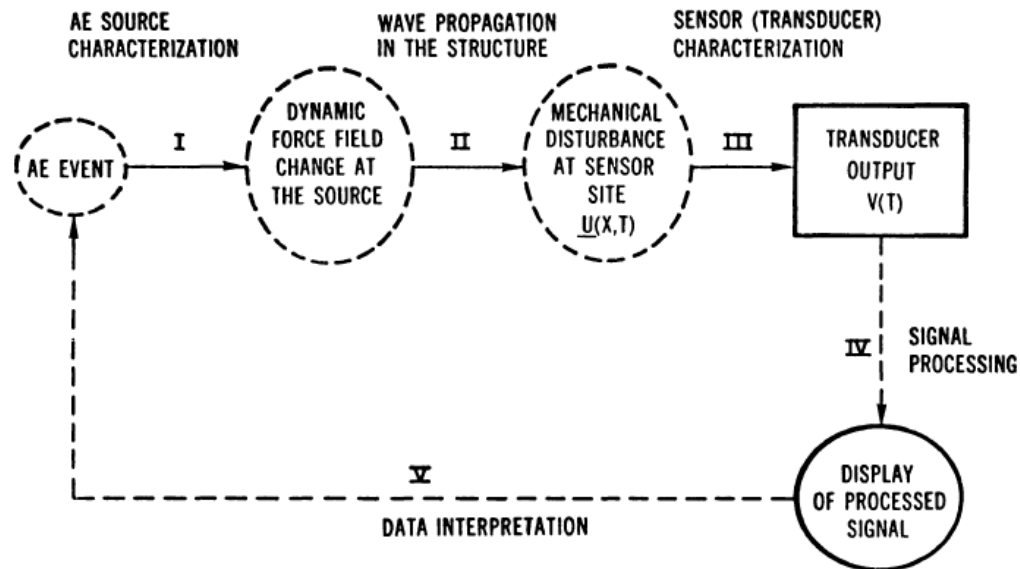
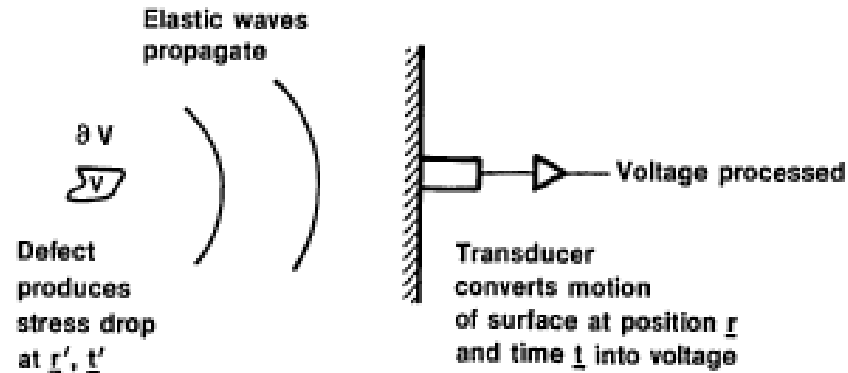
- Galling in sheet metal forming
- Basics of acoustic emission
- Strip reduction testing
 - Test setup
 - Results
- Further steps
- Conclusion

Galling in sheet metal forming



Fig. 1. Deep drawn component, (a) good surface quality, (b) poor quality due to galling

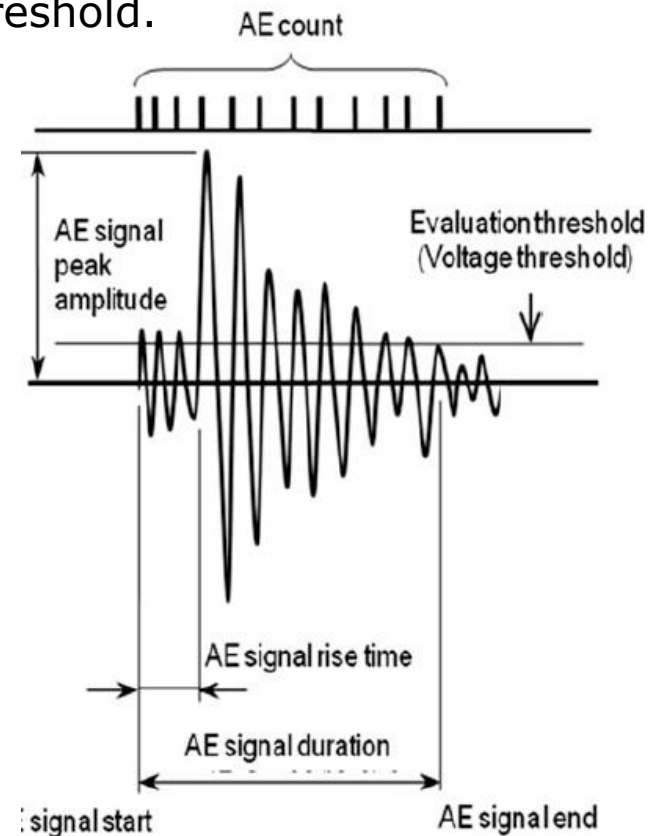
Basic principles of acoustic emission



Characterization of the AE signal

“ISO 12716:2001 Non-destructive testing - Acoustic emission inspection”

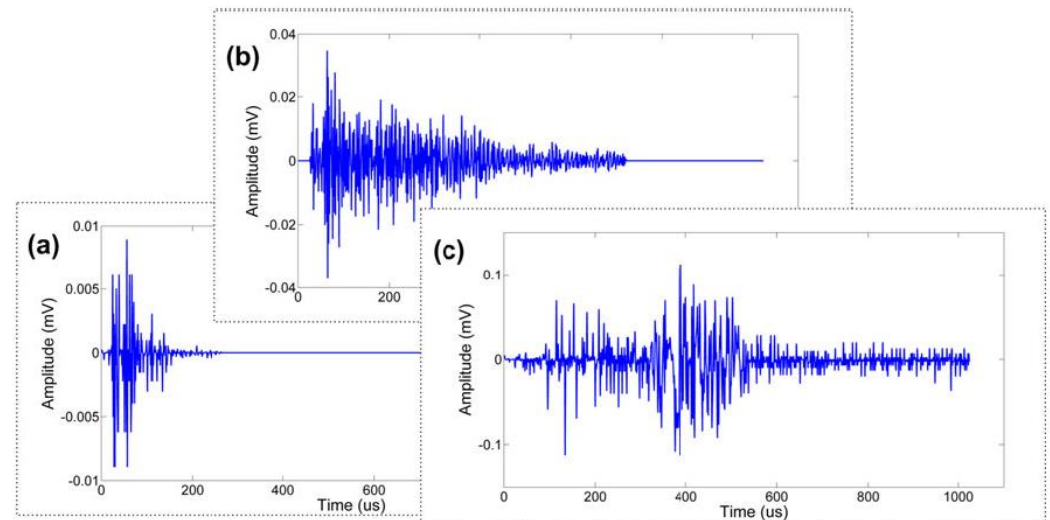
- AE event counts above the voltage threshold.
- Averaged signal intensity
- Peak amplitudes
- AE energy
- Duration and rise time of AE events
- Frequency spectral analysis
- Wavelet analysis



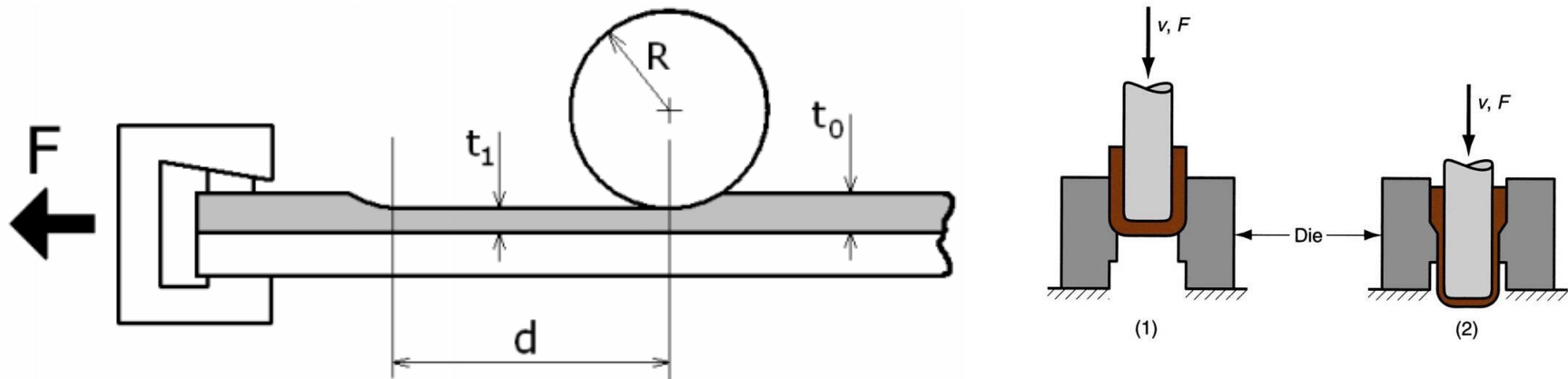
Applications for acoustic emission

- Structural health monitoring
 - Crack development in concrete structures
 - Delamination of composite materials
 - Disbonding of corrosion products

- Process monitoring
 - Tool wear in turning
 - Monitoring of wear in bearings
 - Assessment of process deviations e.g. spot welding, polishing etc.

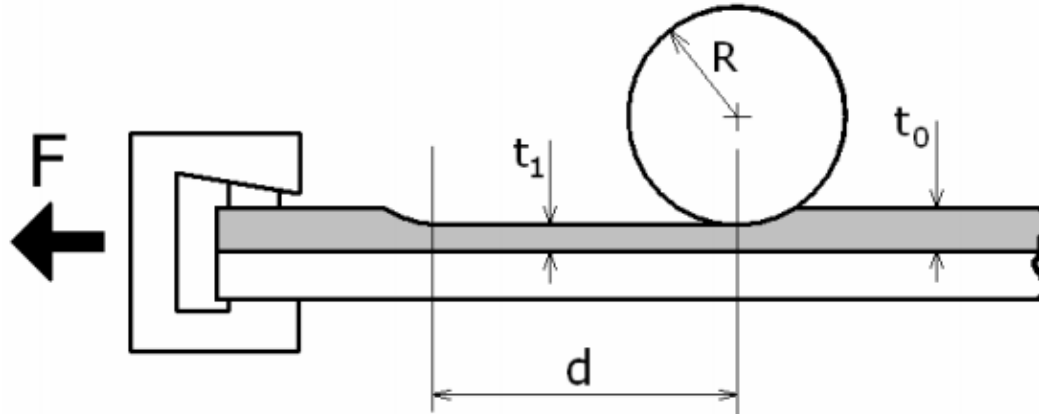


Strip reduction testing



Code	Name	Description	Viscosity at 40°C (cSt)
CR5/Sun60	Houghton Plunger CR5, Sunoco Sun 60	Mixture of 50 wt.% Sunoco Sun 60 plain low viscosity naphthenic mineral oil and 50 wt.% Houghton Plunger CR5 high viscosity mineral oil.	60 [30]
Pn226	Castrol Iloform PN 226	Medium additive mineral oil with chlorine based EP additives [31].	66

Strip reduction testing

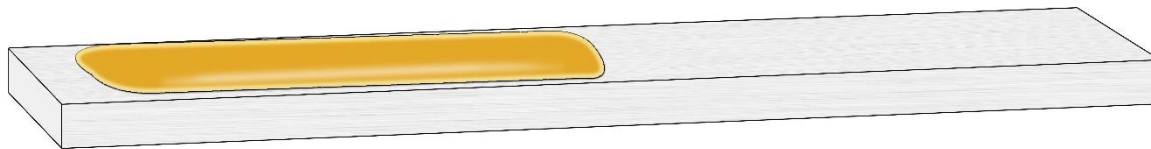


Tool: Ø15 DIN W. no.13344 PM

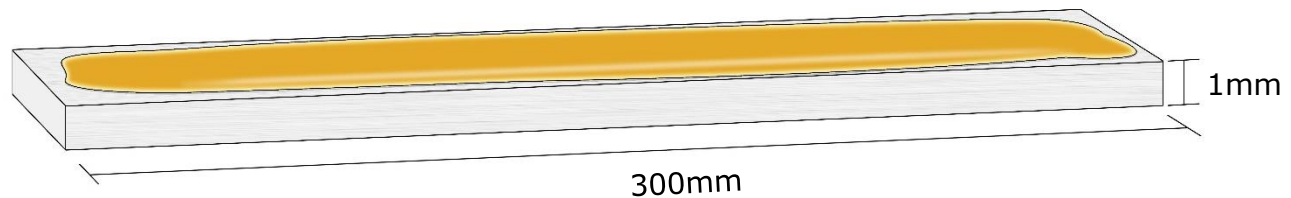
Ra 0,02

Strip material: 304L stainless steel, 20% reduction

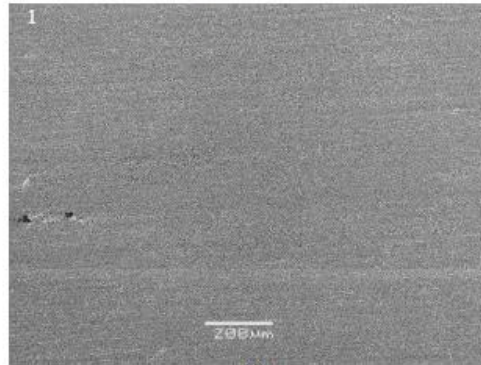
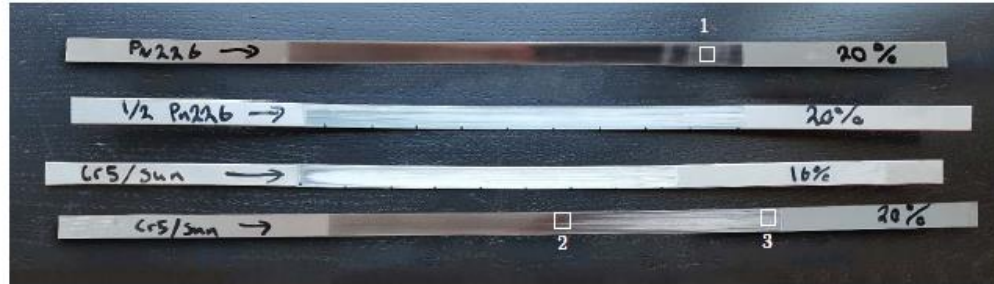
Partially lubricated strip



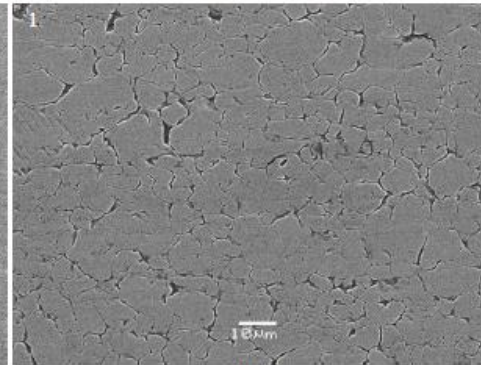
Fully lubricated strip



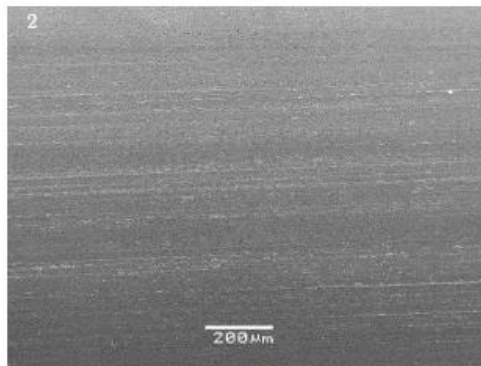
Surface roughness upon strip reduction



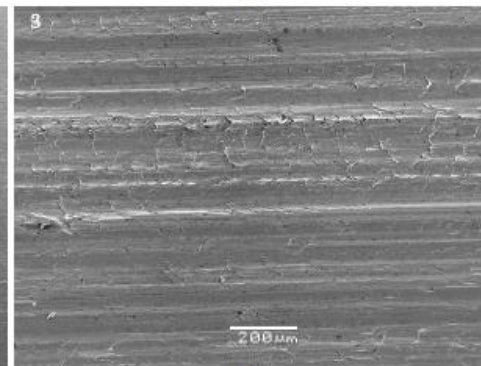
(a)



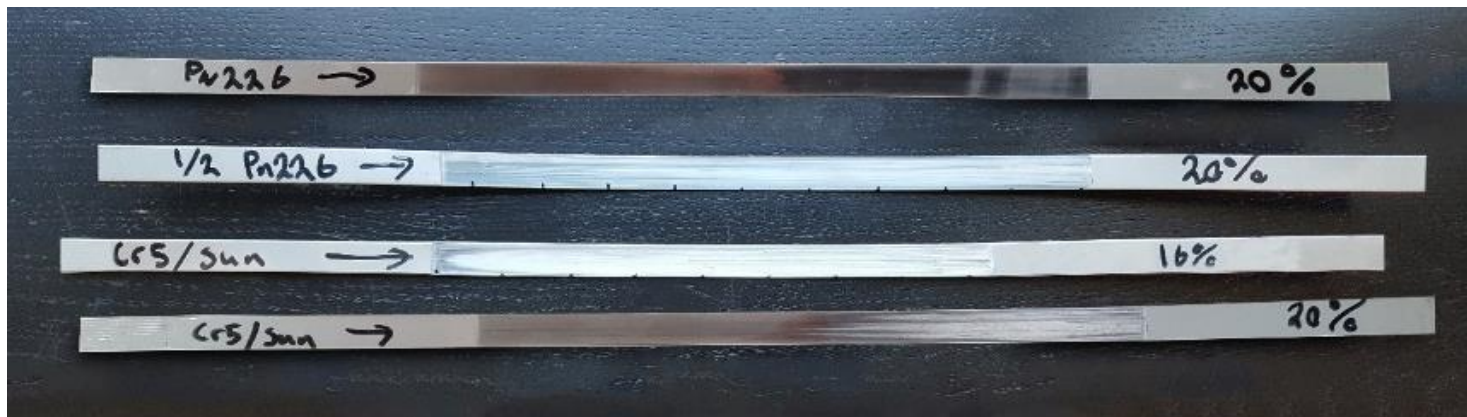
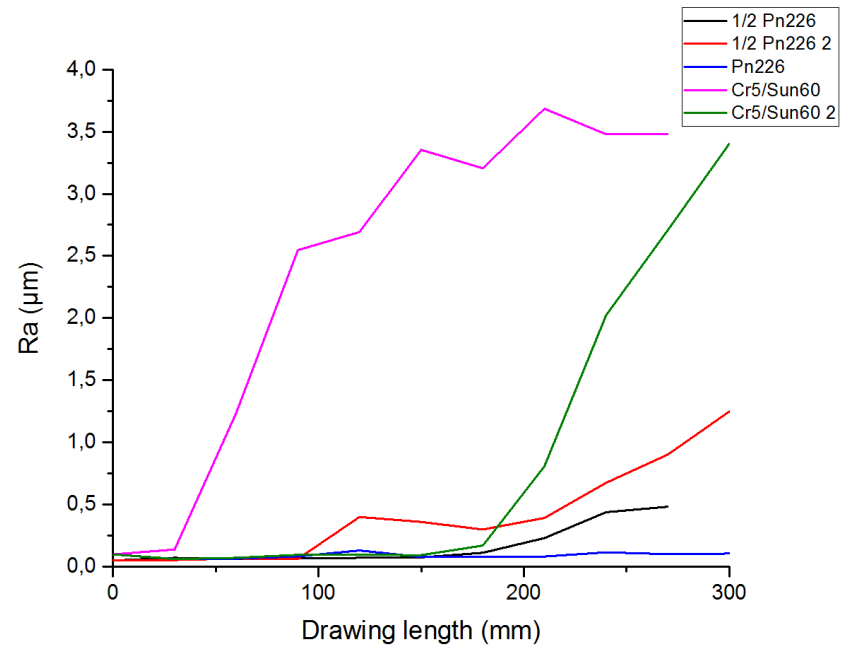
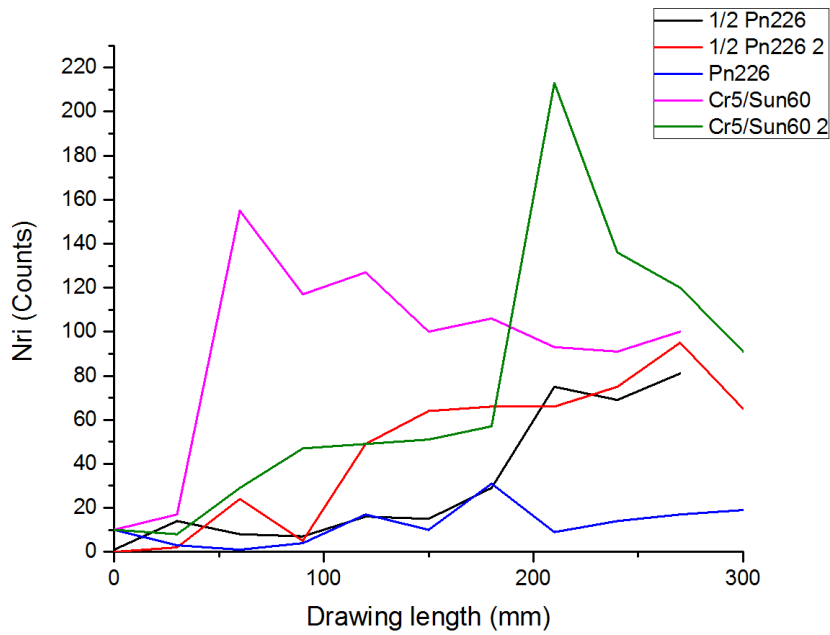
(b)



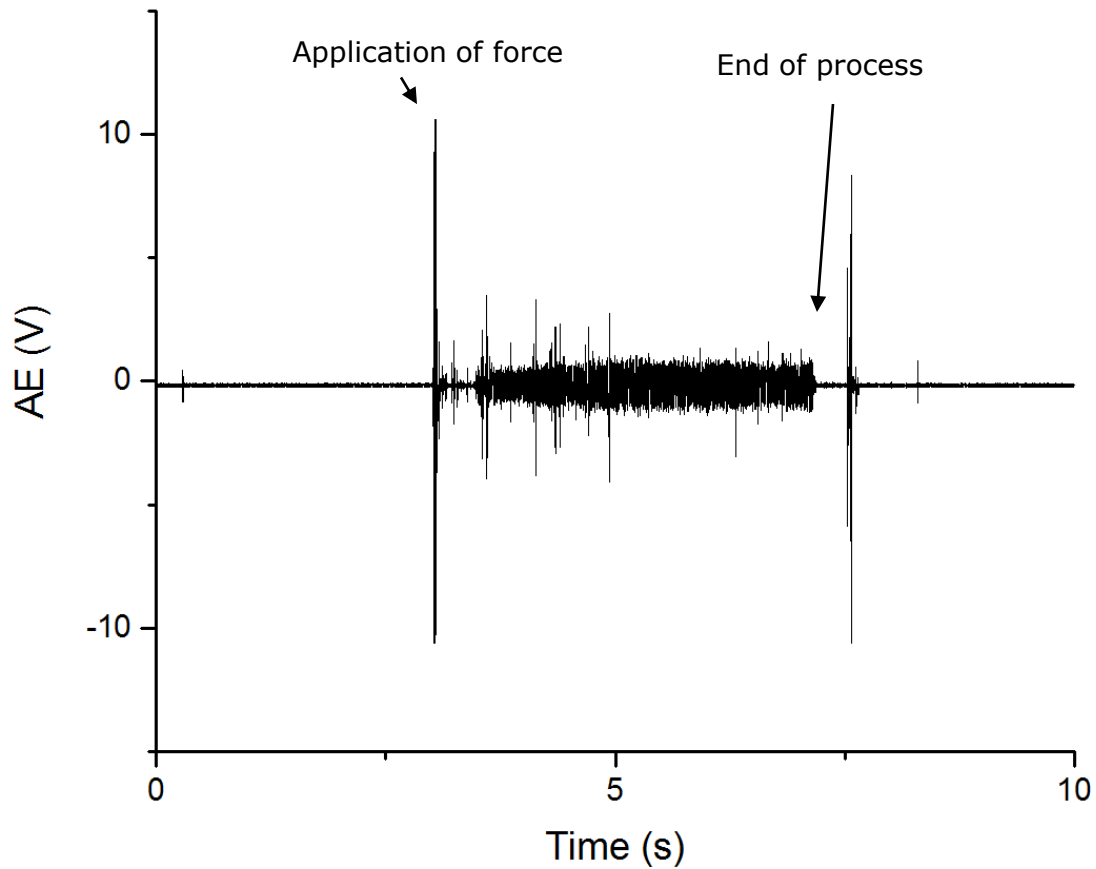
(c)



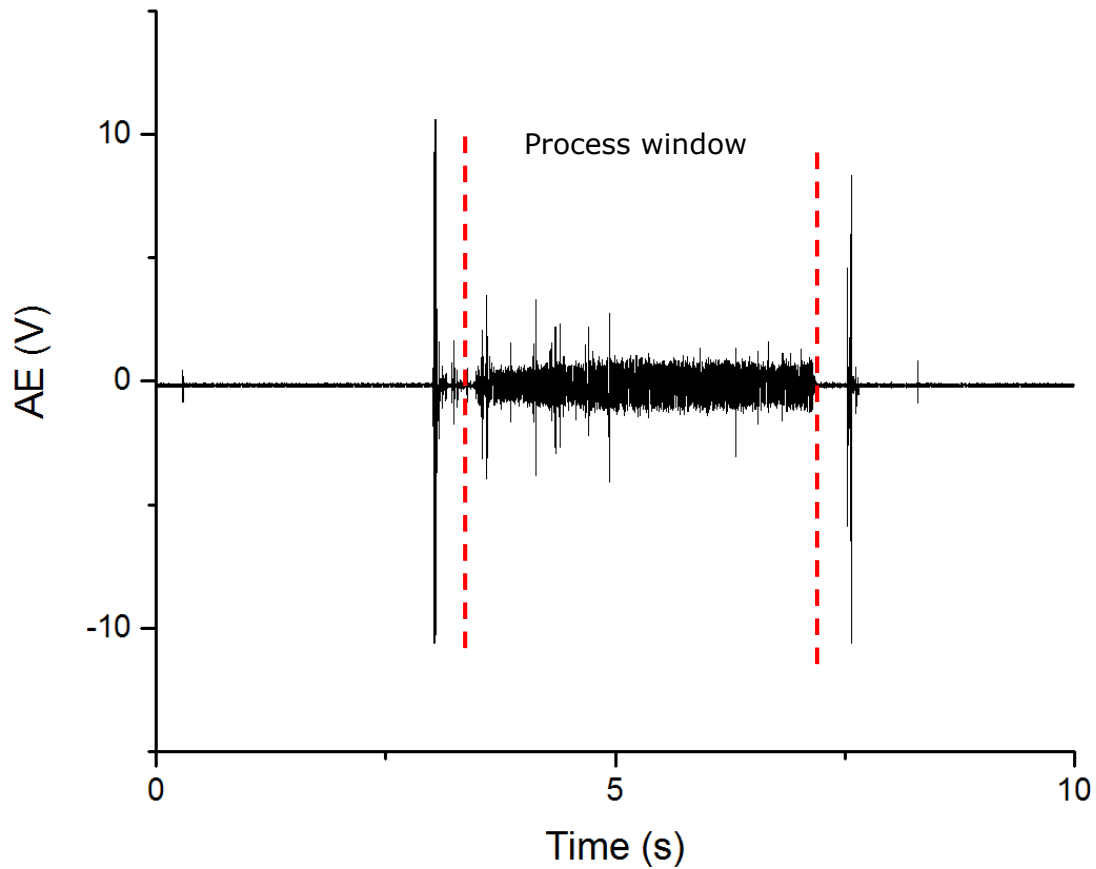
(d)



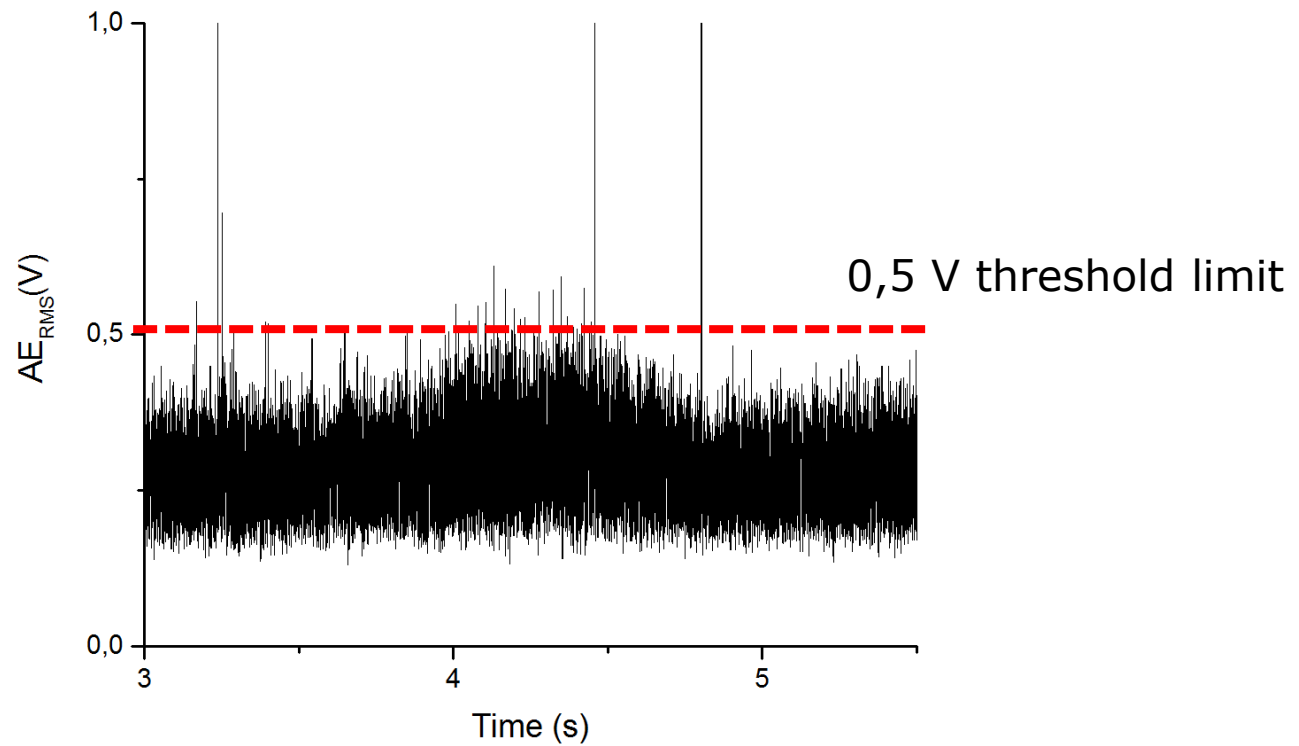
AE signal during strip reduction



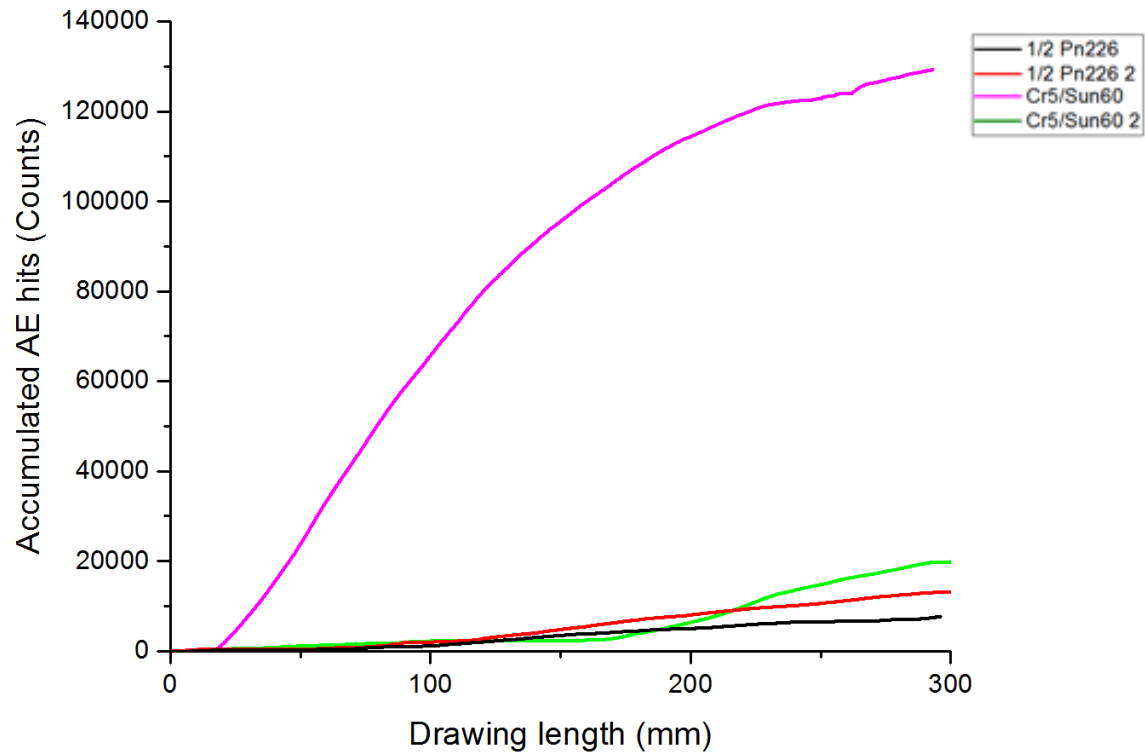
AE signal during strip reduction



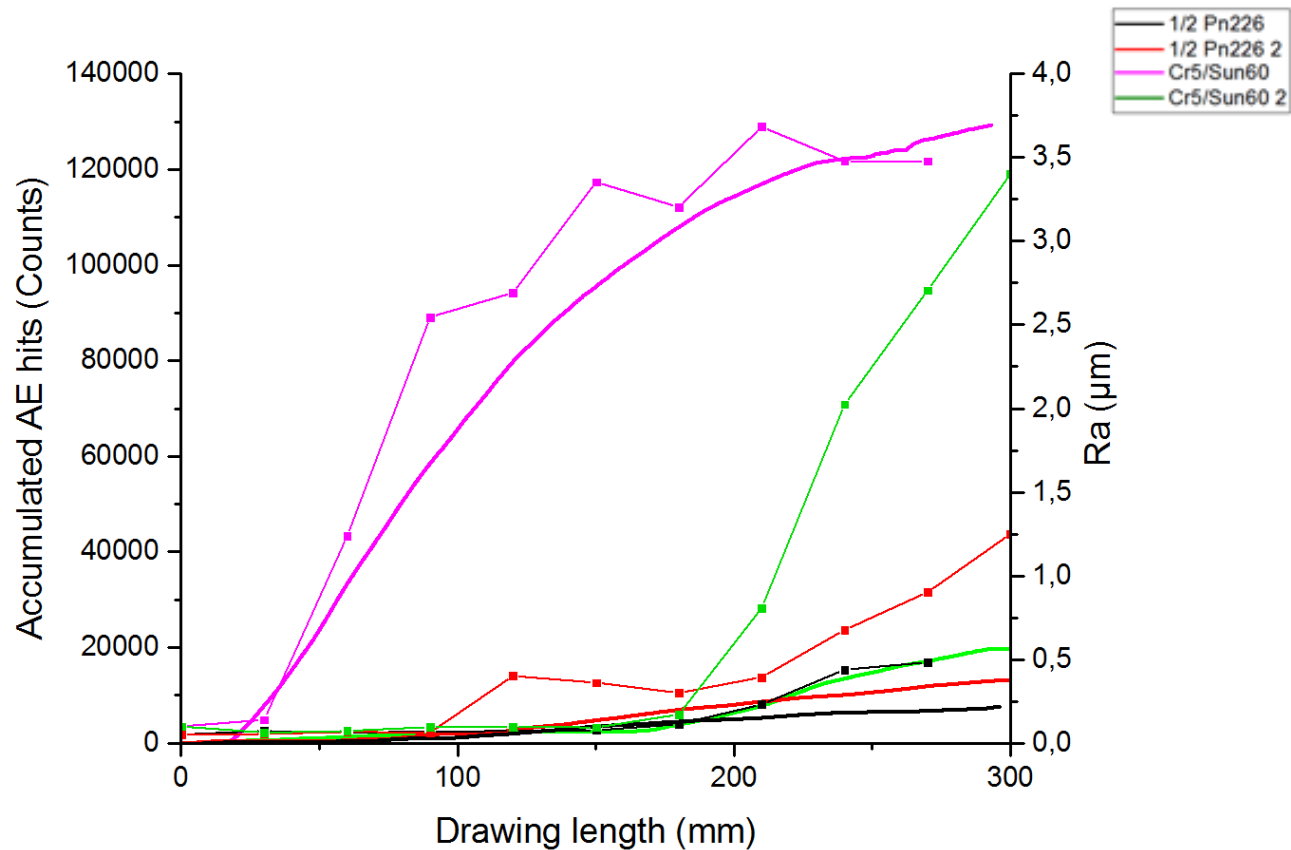
Threshold limit



Accumulated AE hits



AE hits and developed surface roughness



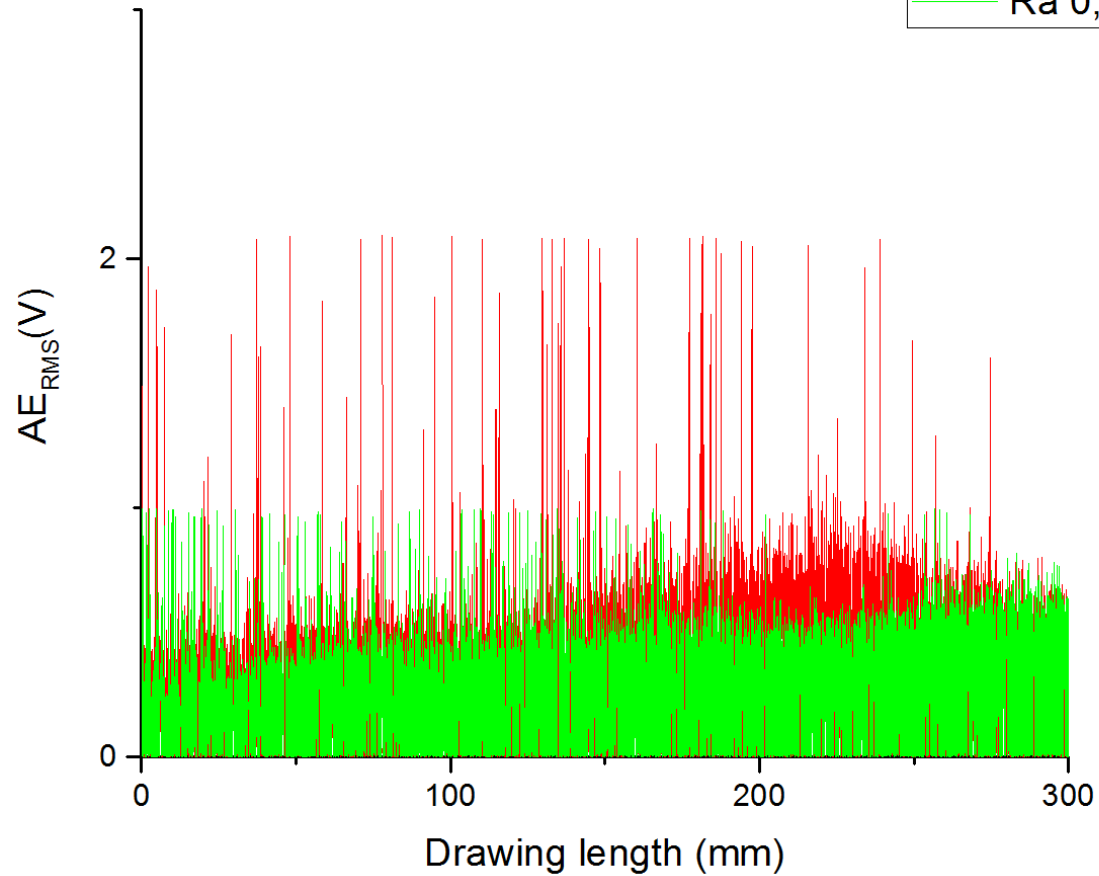
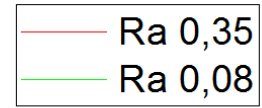
Further steps

- The AE methodology allows for detection of deviations in the process of strip reduction.
- Minor discrepancies are found with this technique at lower rates of galling.
 - Testing less tribologically severe tests
 - Study the influence of the frictional conditions

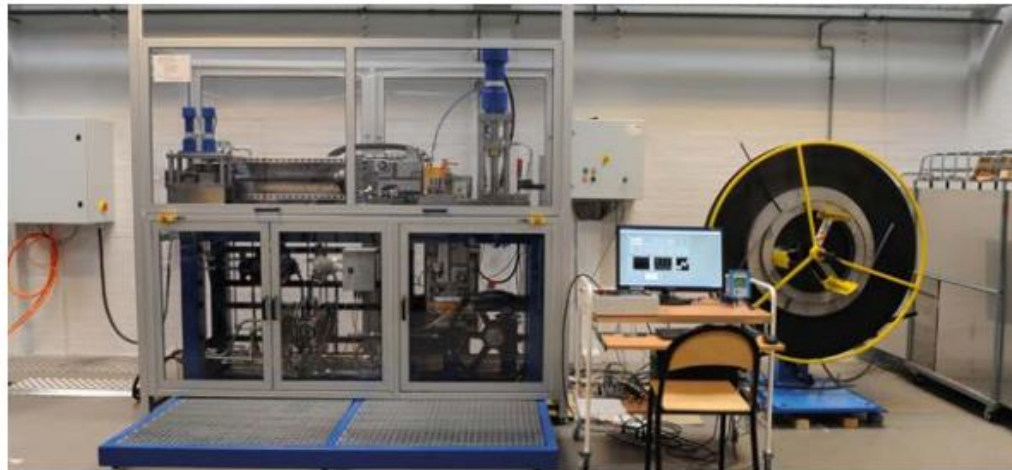
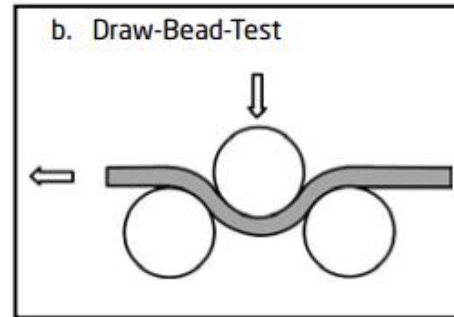
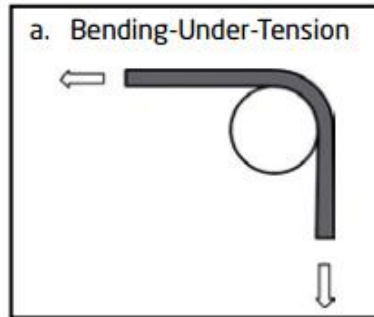


Ra 0,08

Ra 0,35
TDN 81



Less tribologically severe tests



Conclusion

- Acoustic emission can be applied as an indirect, online monitoring technique for detection of the occurrence of galling.
- A correlation is found between the RMS signal and the severity of the wear, indicating the frictional conditions in the tool/workpiece interface.

Questions or comments?