Status and trends of the various components affecting the Field Quality

(20 minutes)

F. Bertinelli AT/MAS

Components supplied 1/2

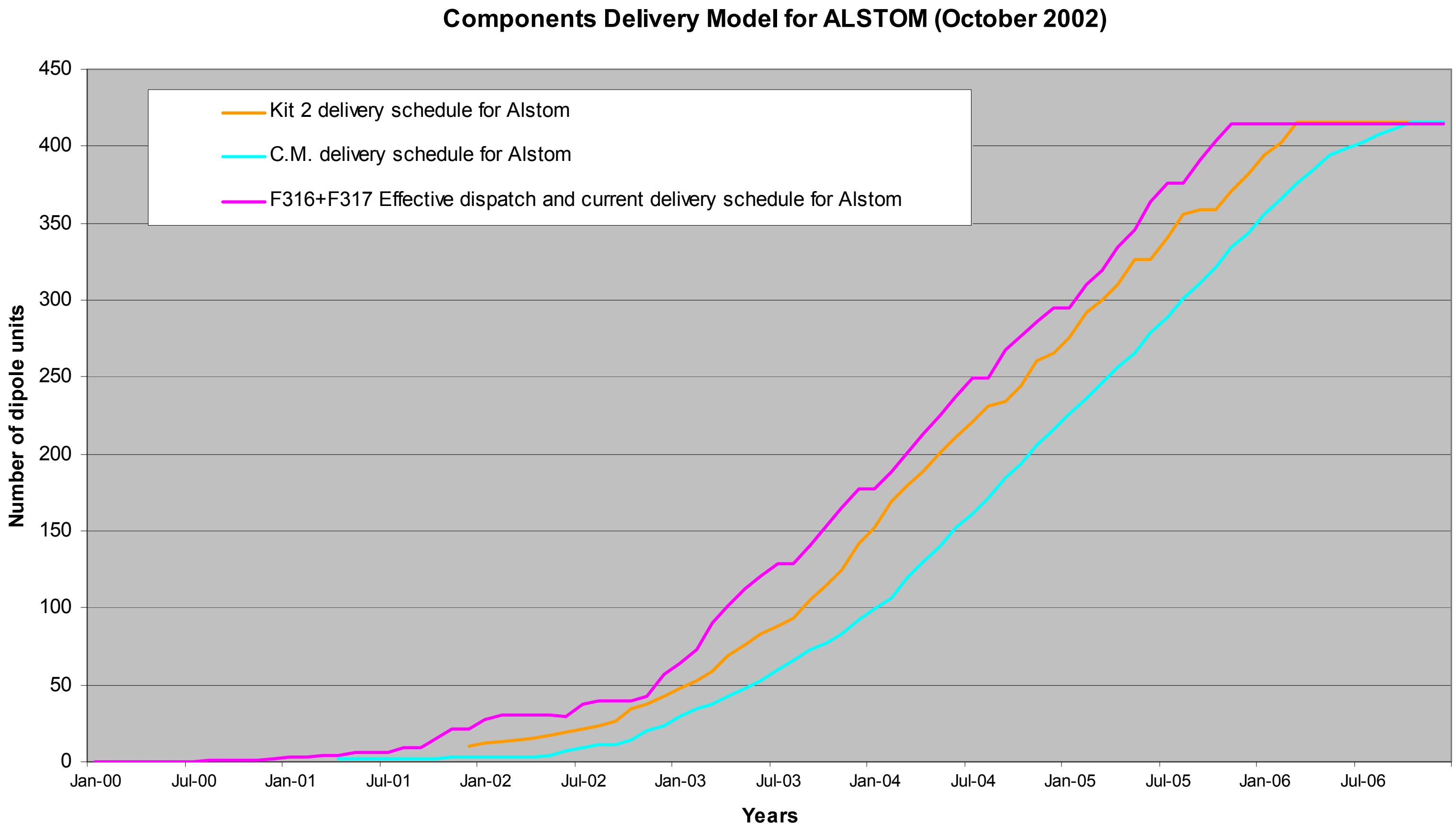
	Contract no.	Component	Supplier	% produced
Kit 1	F313	Copper wedges	Outokumpu (FIN)	27
Kit 2	F307	Austenitic steel for collars	Nippon Steel (JP)	39
	F316 F317	Collars	Malvestiti (IT) FUG/FSG (DE)	15
	F386	Cold bore tubes	DMV (IT)	39

AT-MAS

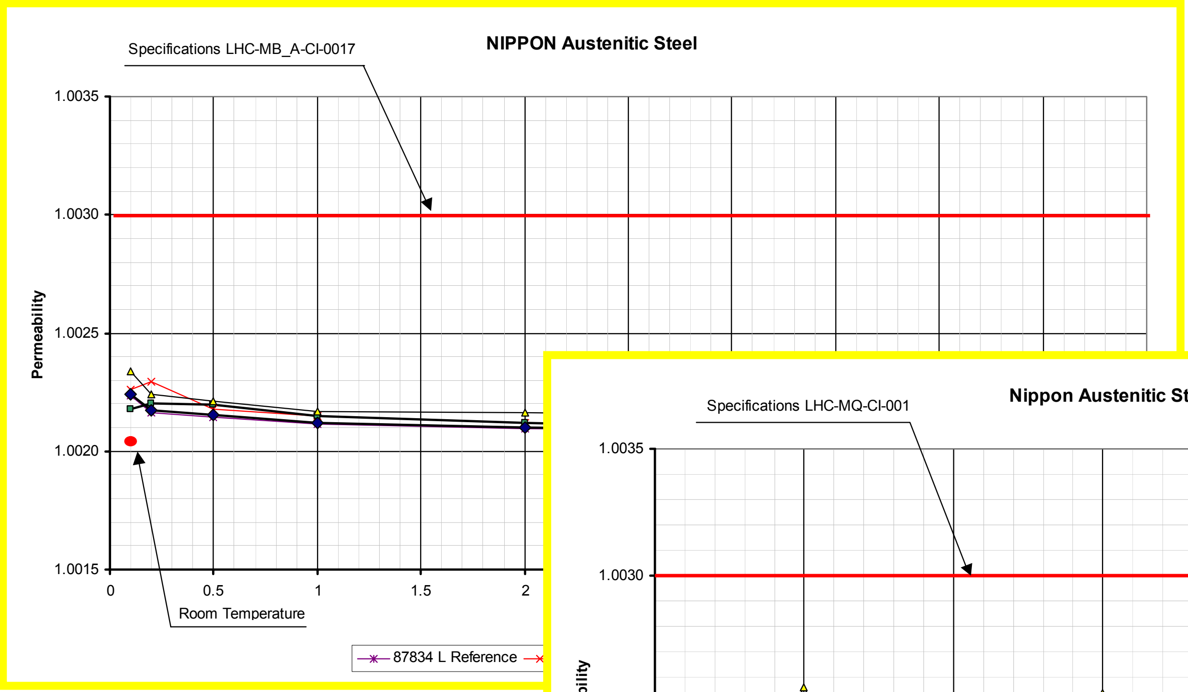
Components supplied 2/2

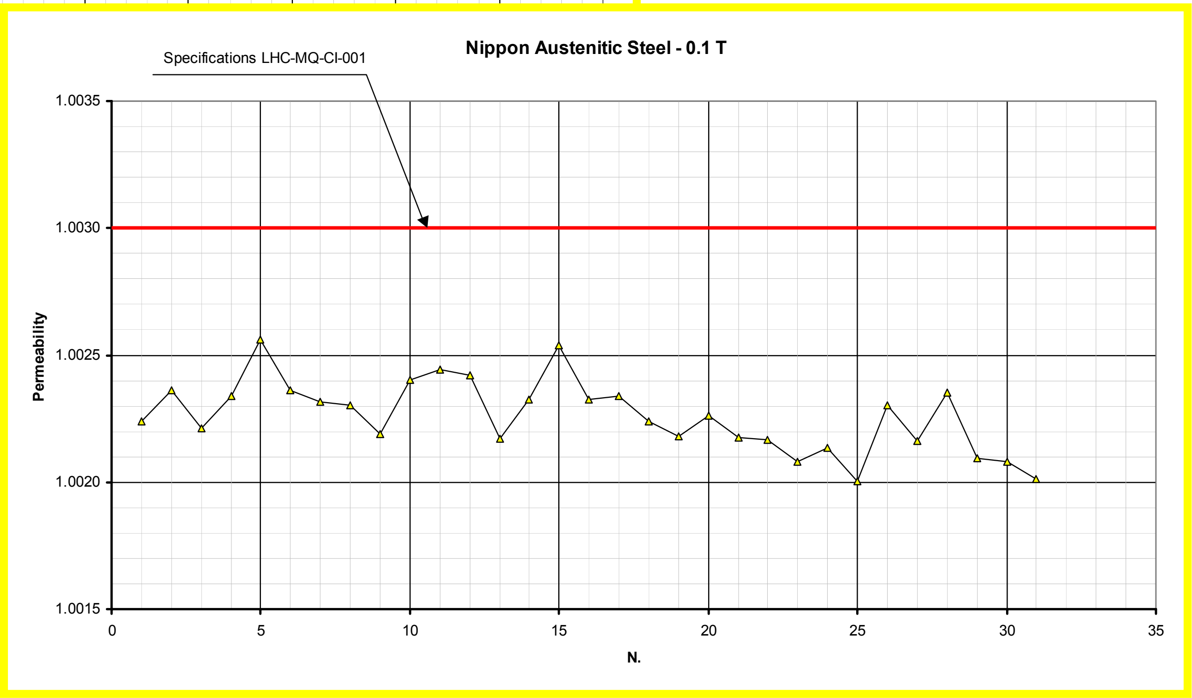
	Contract	Component	Supplier	% produced
Kit 3	F245	Low-carbon steel for yoke laminations	Cockerill (BE)	40
	F314 F315	Yoke laminations	FUG/FSG (DE) ELAY (ES)	20
	F312	Non-magnetic steel for end-yoke laminations	Kawasaki Steel (JP)	85
	F319 F318	End-yoke laminations	Malvestiti (IT) ELAY (ES)	20
	F338	Shells	Butting (DE)	11
	F398	End covers	Metso (FIN)	15
	F389	N-line tubes	DMV (IT)	57
	F482	Copper tubes (HET)	Outokumpu (FIN)	23
		Heat Exchanger Tubes	CERN - EST	8

Delivery plan per CMA

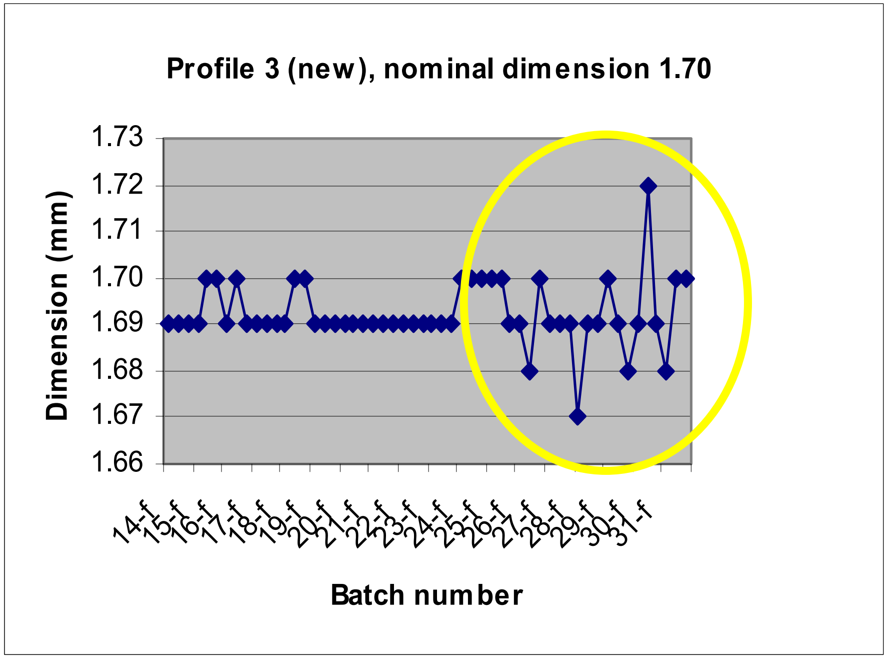


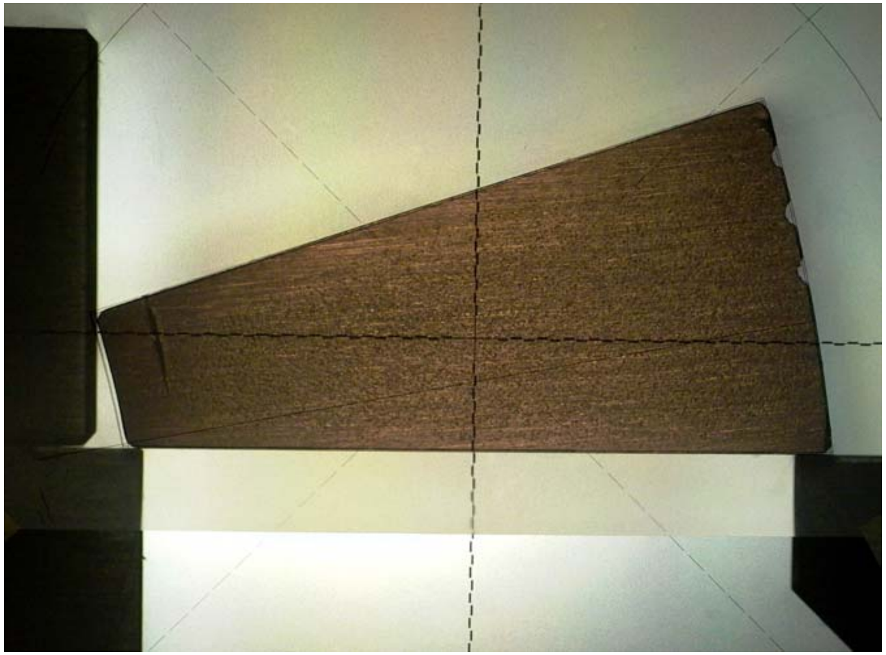
Nippon Steel: permeability





Copper wedges: 1/4

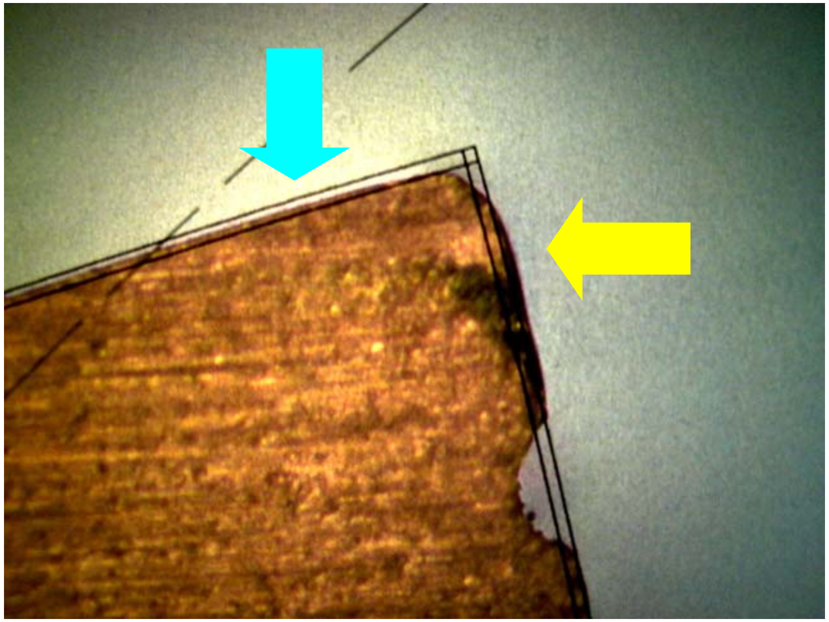




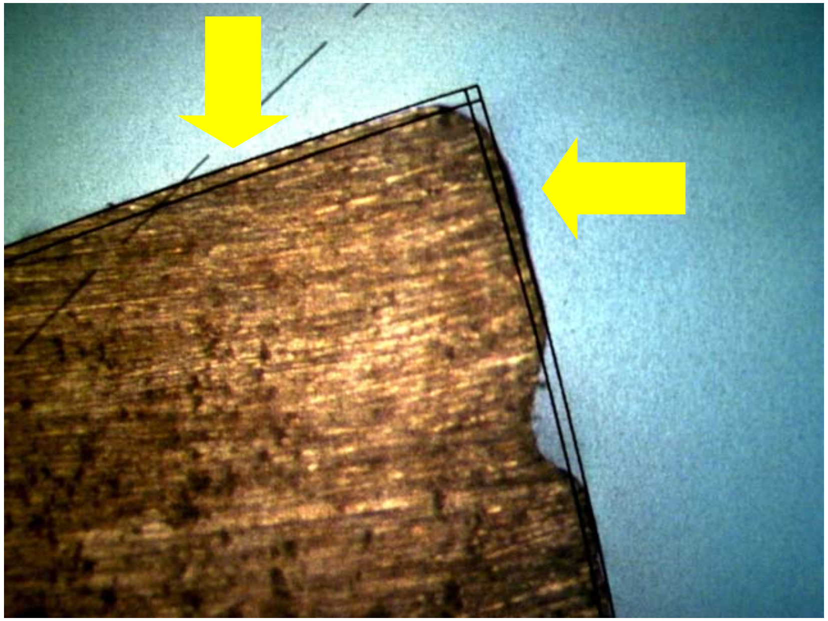
The symptom …

… measurements at CERN …

Copper wedges: 2/4



Batch 14: produced Nov. 2001

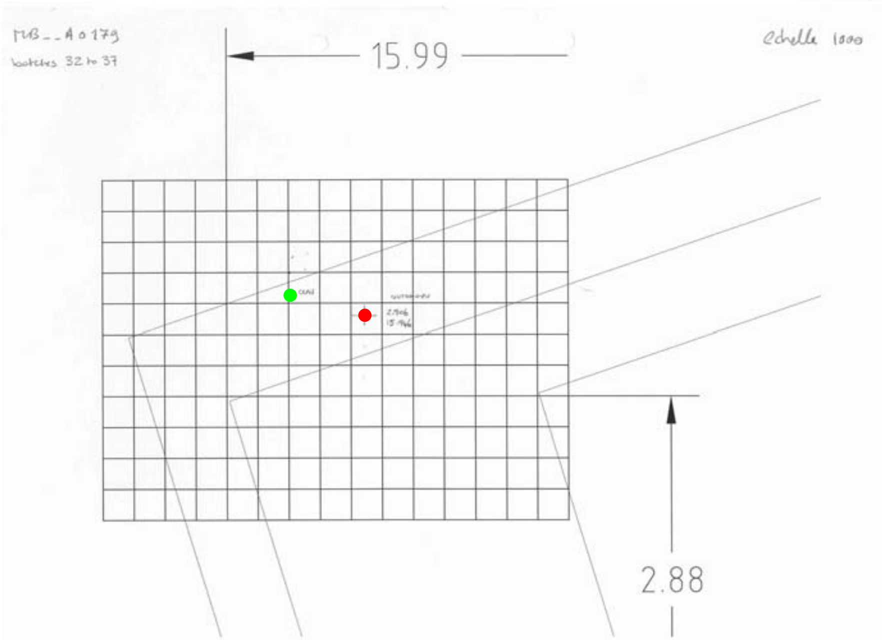


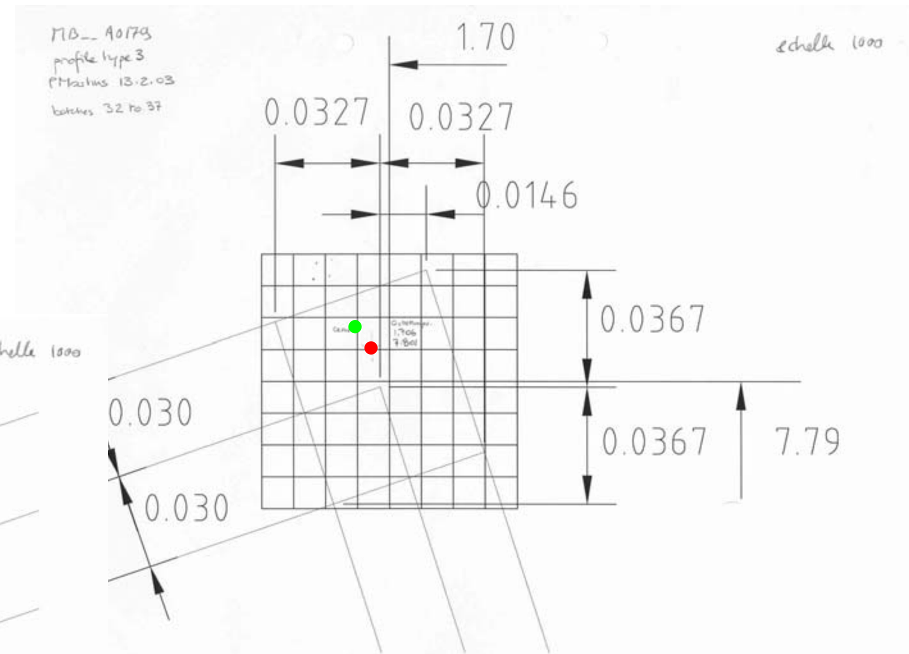
Batch 30: produced Sept. 2002

Effect of drawing dye wear: approx. 0.01 mm

Action: completely replaced the 4 extrusion and 4 drawing dyes with new ones

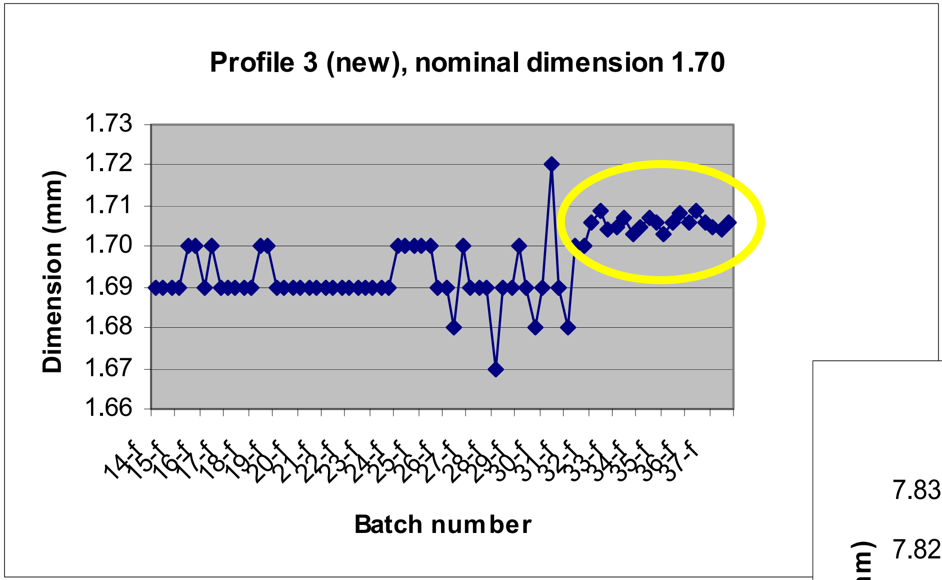
Copper wedges: 3/4

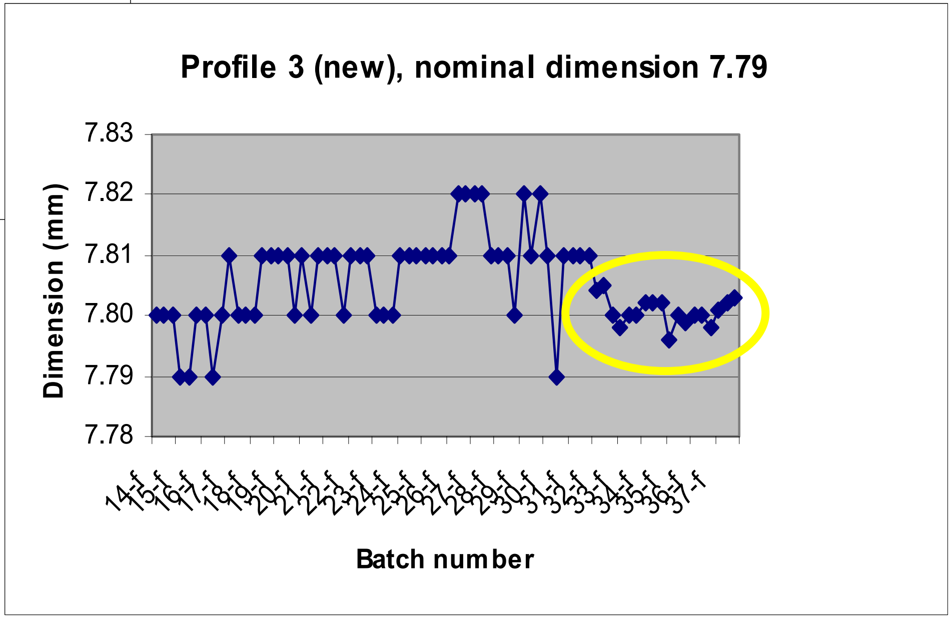




CERN and Outokumpu measurements

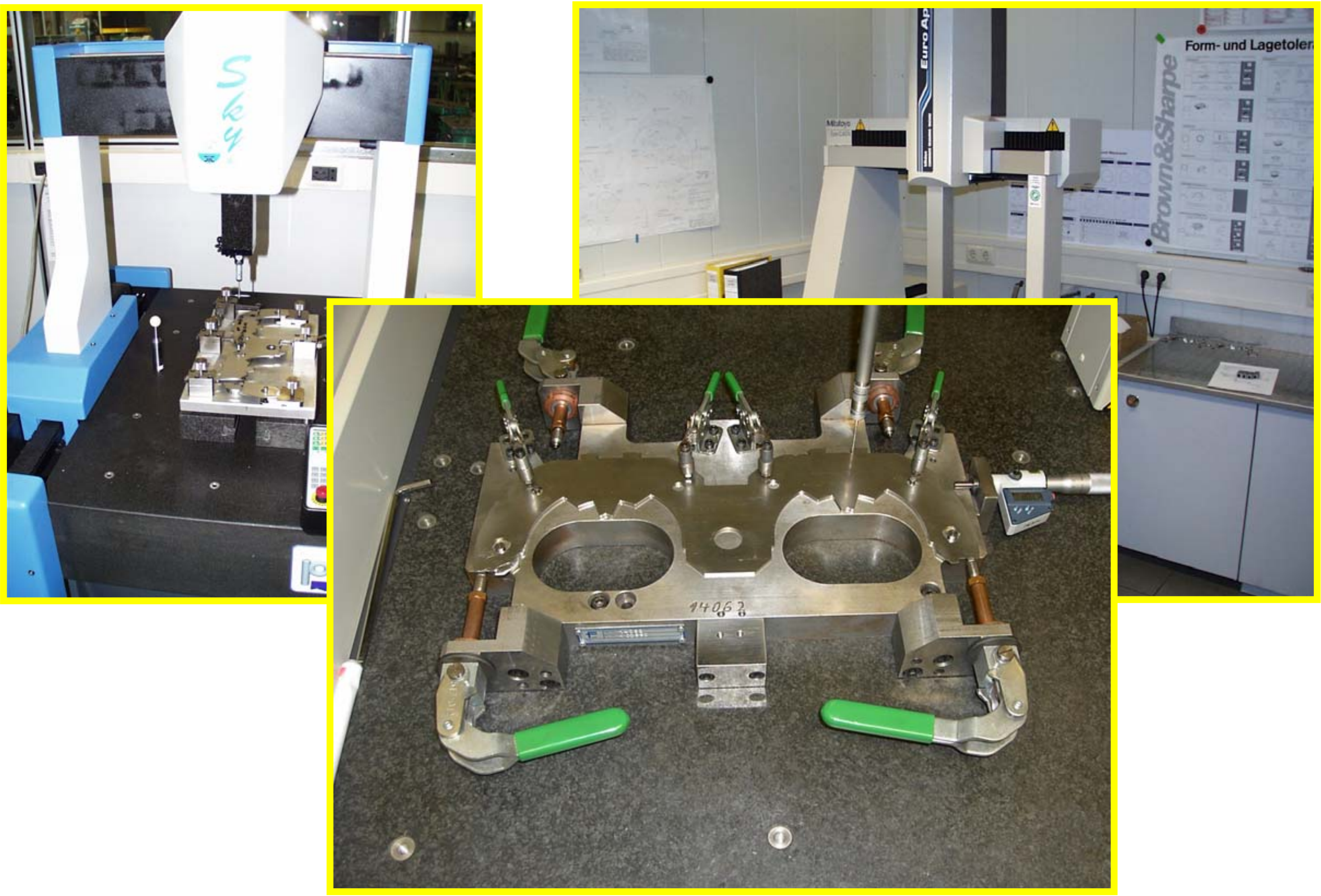
Copper wedges: 4/4



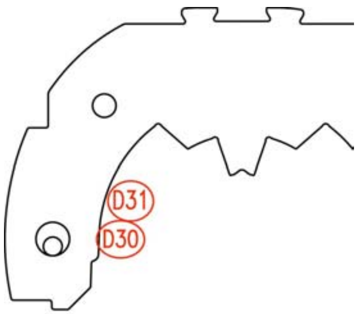


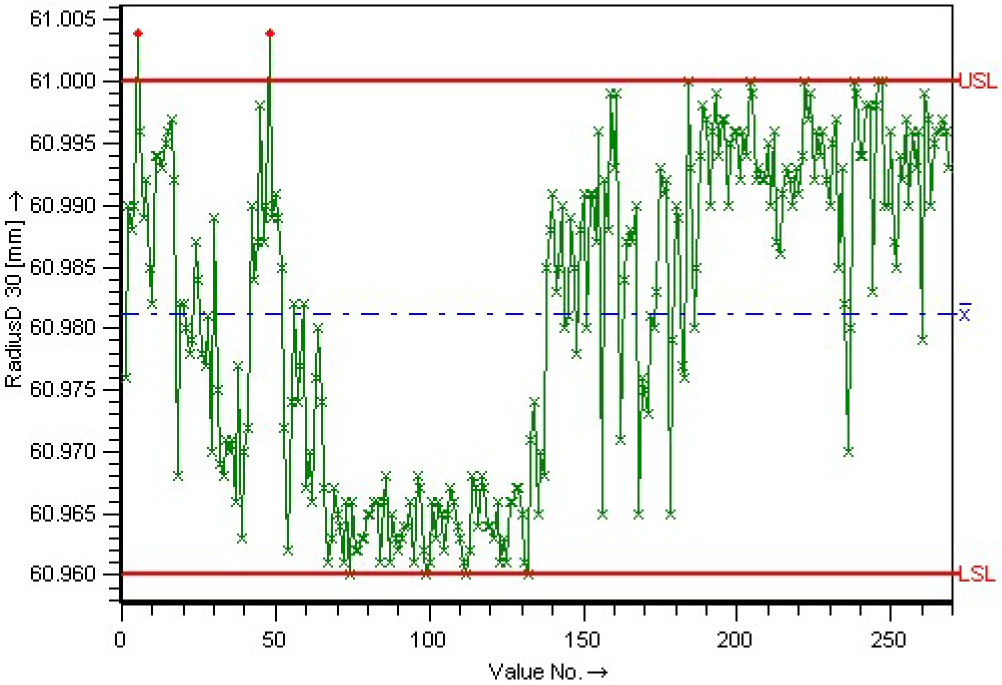
Outokumpu measurements: historical statistics

Collars: 3D measuring method



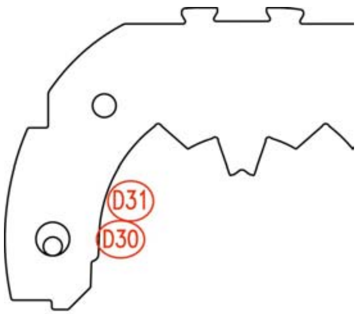
Collars: historical data Malvestiti

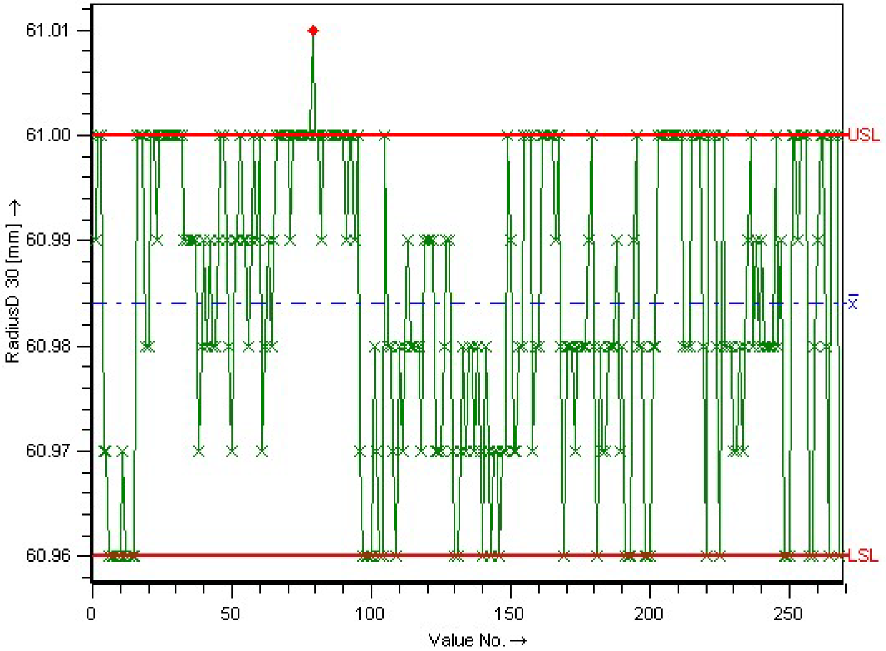




- process under control
- collar dimension within tolerance

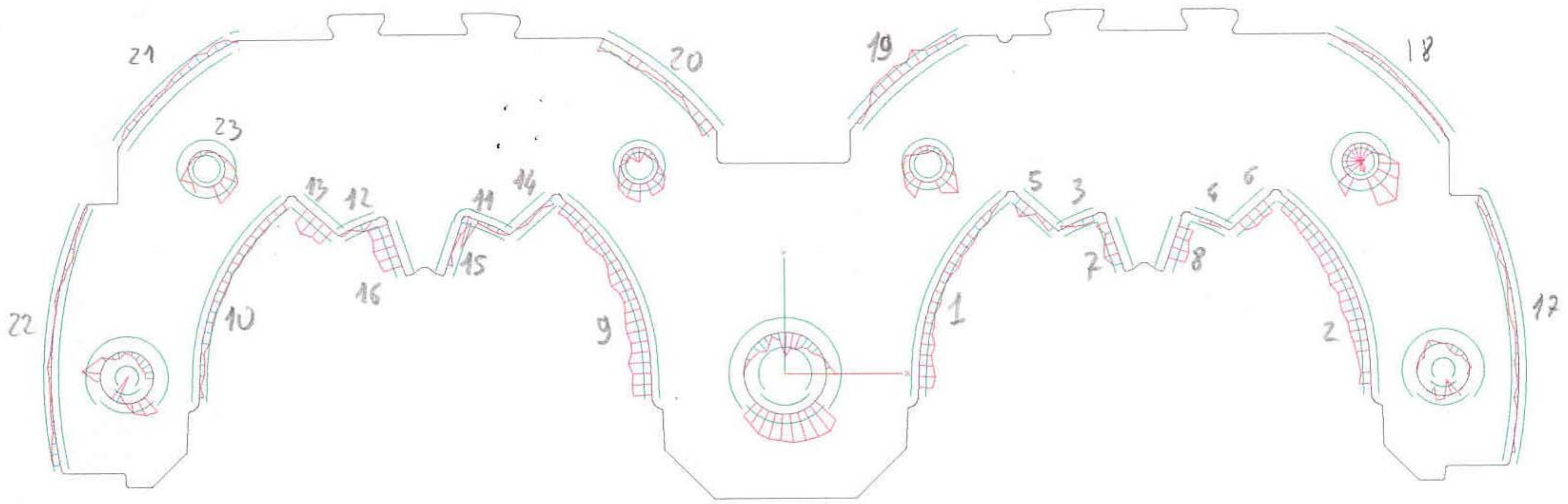
Collars: historical data FUG-FSG





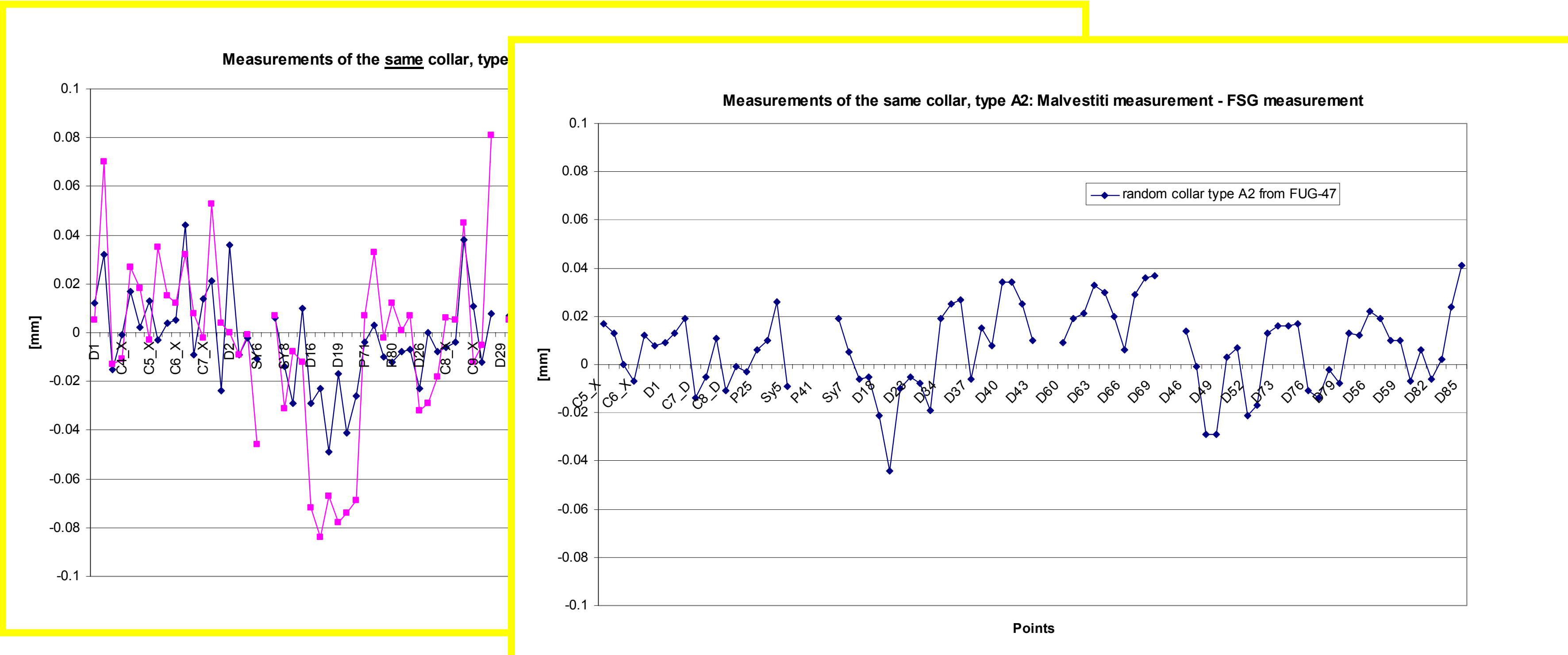
⇨ FSG will supply the raw machine data to CERN (ASCII format) and CERN will process it

Collars: Smartscope measuring method



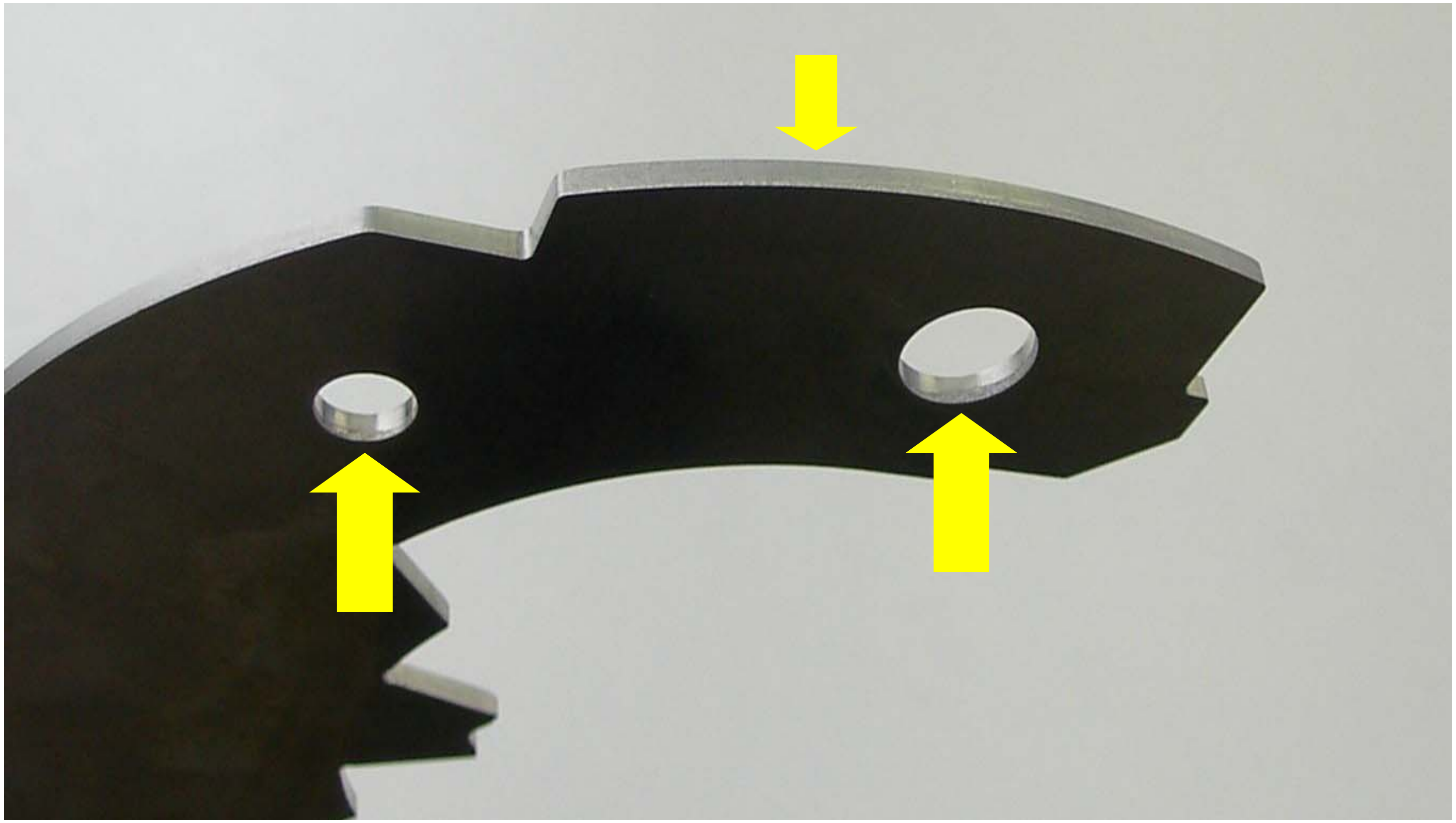
- Smartscope/Smartfit (Malvestiti) measurement of an FSG collar (batch 47, random selection)
- best fit of measured geometry w.r.t. nominal geometry
- results stable w.r.t. FSG tool approval (April 2001)

Collars: validation of 3D measuring methods

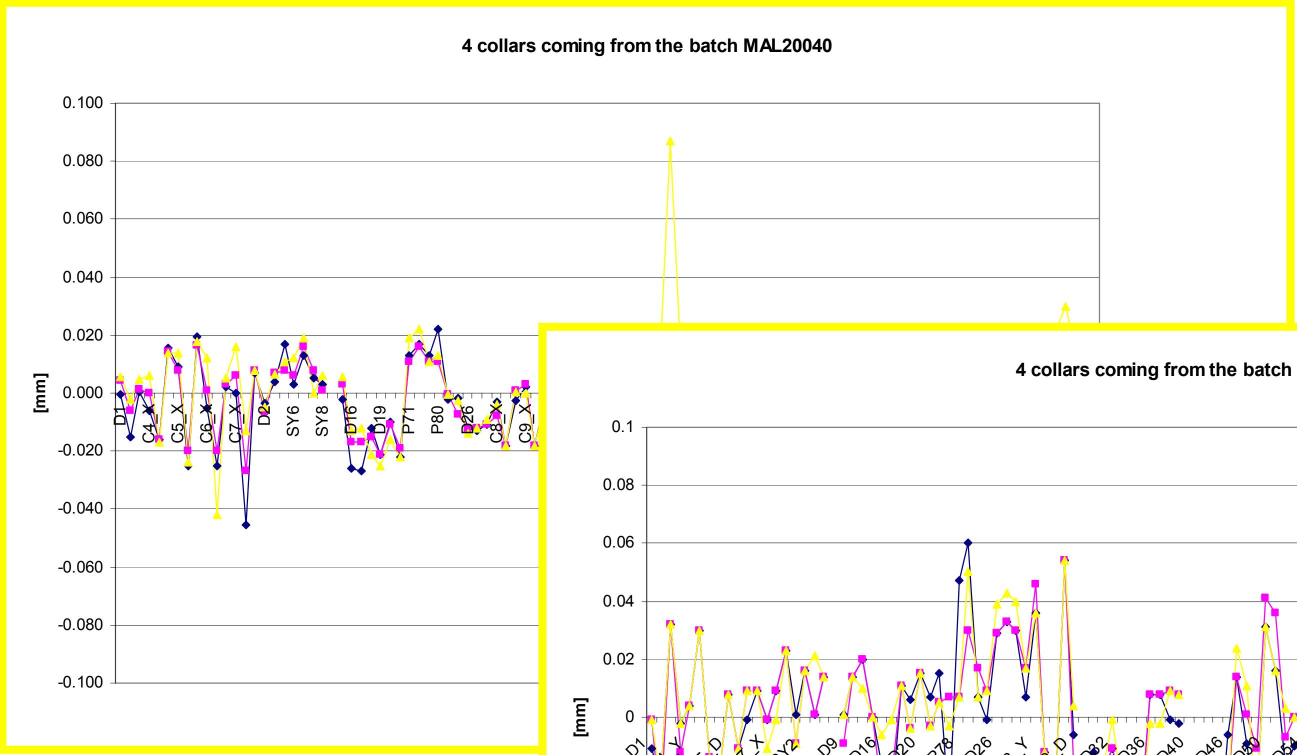


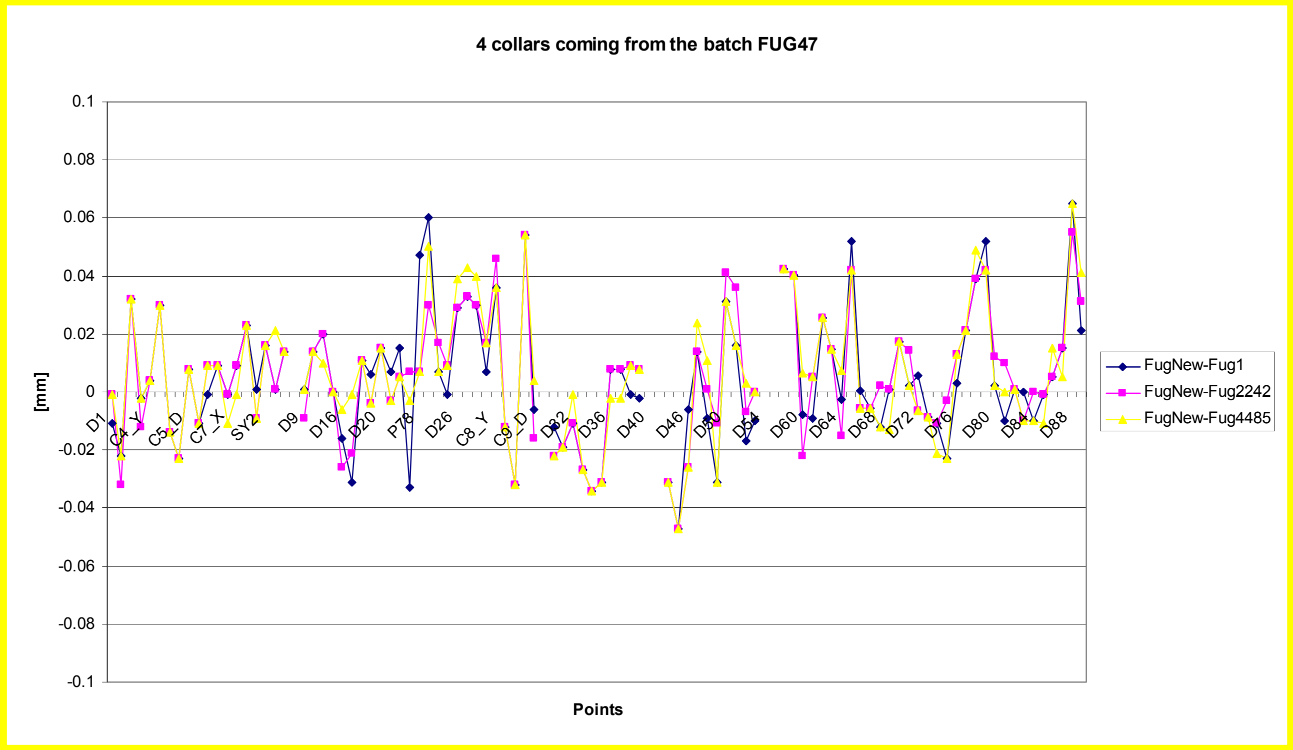
- probe geometry (strong dependance on cut quality)
- support and positioning of collar for measurement (?)
- selection of reference axes (?)
- format of results (e.g. geometrical tolerances)

Collars: cut quality

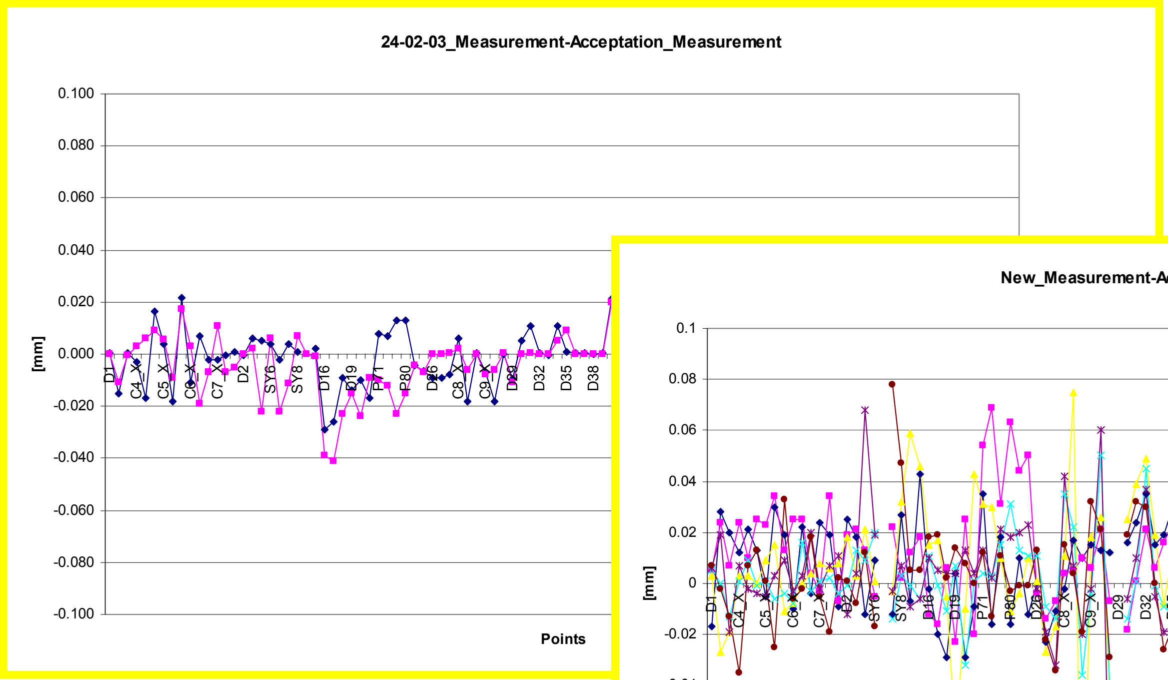


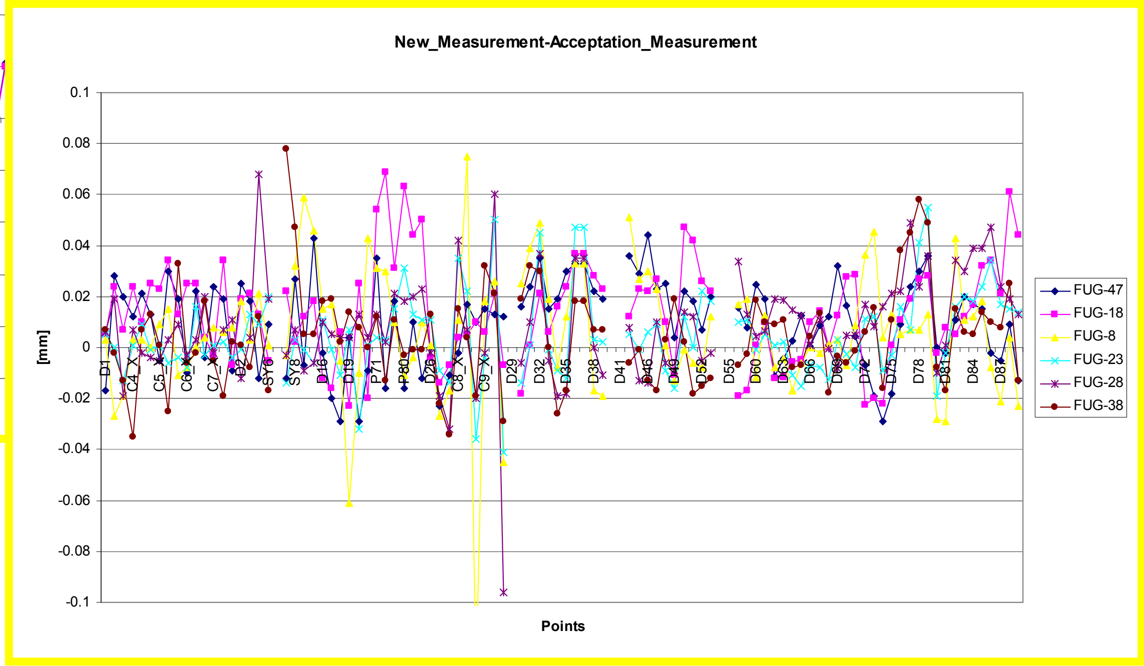
Collars: random sample vs acceptance values





Collars: repeatability of results





Collars: what next?

- “Trimicron” machine: not the solution for a better knowledge of collar geometry
- if necessary, obtain more knowledge using Smartscope, then use 3D to monitor stability of production
- follow-up the differences in measurement method
- try to reduce the uncertainty from ± 0.04 to ± 0.02 (is it worth it?)

Conclusions

From November 2002 Magnet Review…

- " … We need to implement:
  - SPC quality control common for all contracts and reporting
  - a regular cross-check at CERN of measurements done by Suppliers (priority: collars, end covers, shells): i.e. an investment but extra costs
  - Check state of components stored since years …..”

There is a real risk of “blindness from numbers”, i.e. rely too much on paperwork from Suppliers – risk of “routine”

Continue to improve quality of components (not only geometry…)