

LHC collimators

Mechanical point of view

1 Collimator number and types.

2 Parameters for technical specification.

3 Collimators in LHC tunnel.

4 Present status of collimator studies

1 Collimator number and types.

A total of 66 collimators, 1 or 2 moveable jaws, are repertoriated for:

– Momentum cleaning in IR3:

1 primary (TCP: H plane) 200mm Al, Ti, or other light material jaws
Associated with
6 secondaries (TCS: H, S(kew), V plane) 500mm Cu jaws per beam.

– Betatron cleaning in IR7:

4 primaries (TCP, H, S, V plane) 200mm Al, Ti, or other light material jaws
Associated with
16 secondaries (TCS, 4xH, 4xS, 4xV plane) 500mm Cu jaws for per beam.

– Injection single pass cleaning:

2 tertiaries (TCL, V plane) 1000mm Cu jaw(s) in IR2R for beam1 and
in IR8L for beam2.

– High luminosity region protection:

2 tertiaries (TCL, H plane) 1000mm Cu jaw(s) per beam in IR1 and in IR5

2 Parameters for technical specification.

Aperture limits:

-1- Maximum: ϕ 48mm to be confirmed.

_ It defines the transition pieces length ($\sim 100\text{mm}$), to avoid impedance perturbations, on both ends of the jaws.

-2- Operating aperture at 7 TeV:

_ Hence the primary collimator jaws are closed at $\pm 6\sigma$ ($\sigma_{\text{col}} \sim 150 \mu\text{m}$)
total aperture is $\sim 1.8\text{mm}$ (fig. 1).

Jaw positioning precision and quality:

-1- Jaw positioning:

_ No absolute positions are required: only position wrt local beam position and size.

_ Precision required in relative position: $\pm \delta x$, $\delta x \leq 0.3 \sigma_{\text{col}}$ ($\sim 50\mu\text{m}$).

_ Stepping increment: $2.5 \mu\text{m}$ expected, $5 \mu\text{m}$ in LEP.

_ Position repeatability: $< \frac{1}{2} \text{step}$ ($< 2 \mu\text{m}$ achieved in lab).

-2- Jaw quality:

_ Flatness: $20 - 50 \mu\text{m}$ ($120 \mu\text{m}$ achieved in LEP with composite jaw: fig. 2).

_ Surface roughness: $1.6 \mu\text{m}$ high quality machining.

_ Tolerances in angle: $\pm 0.1 \text{ mrad}$.

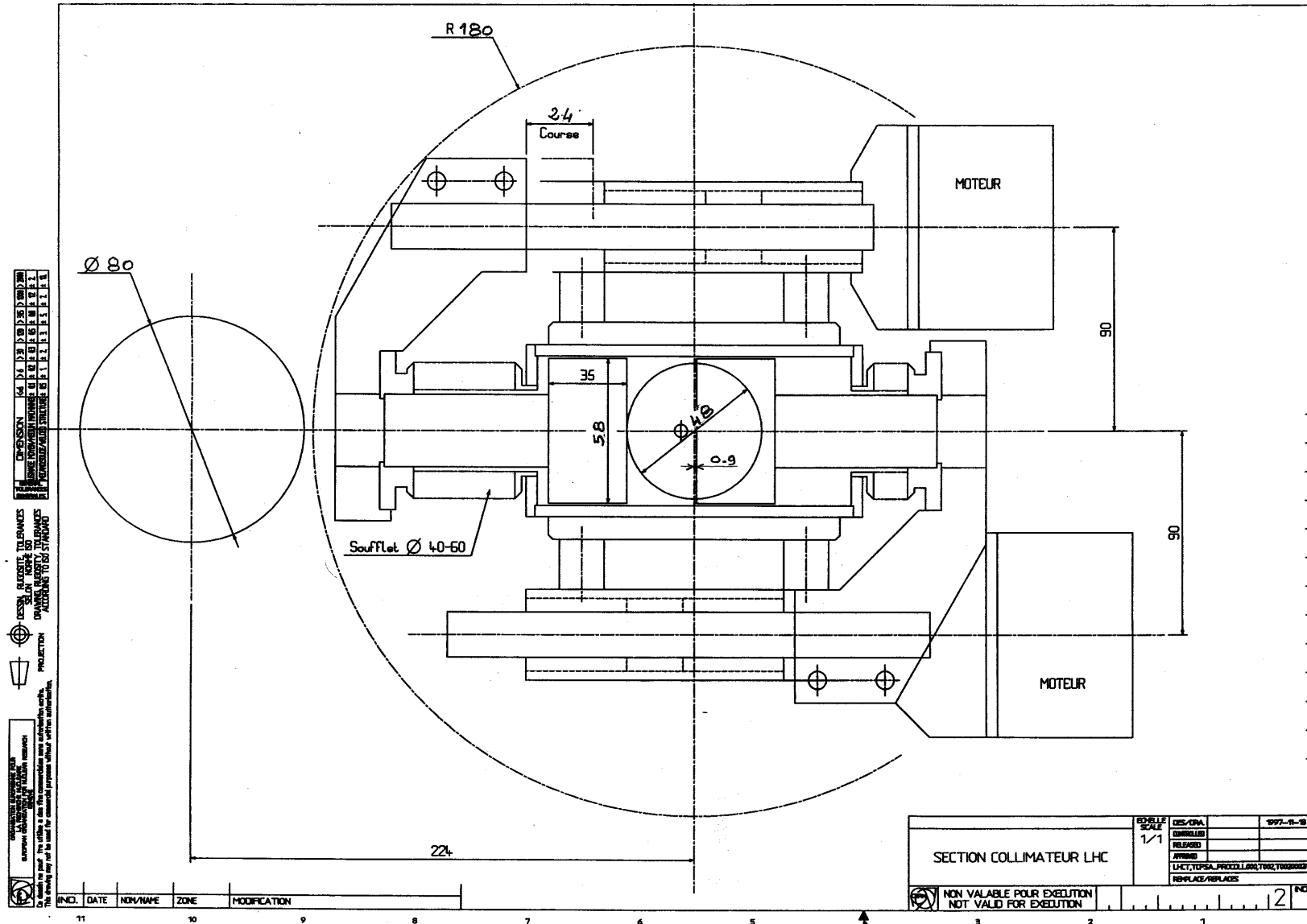


fig. 1

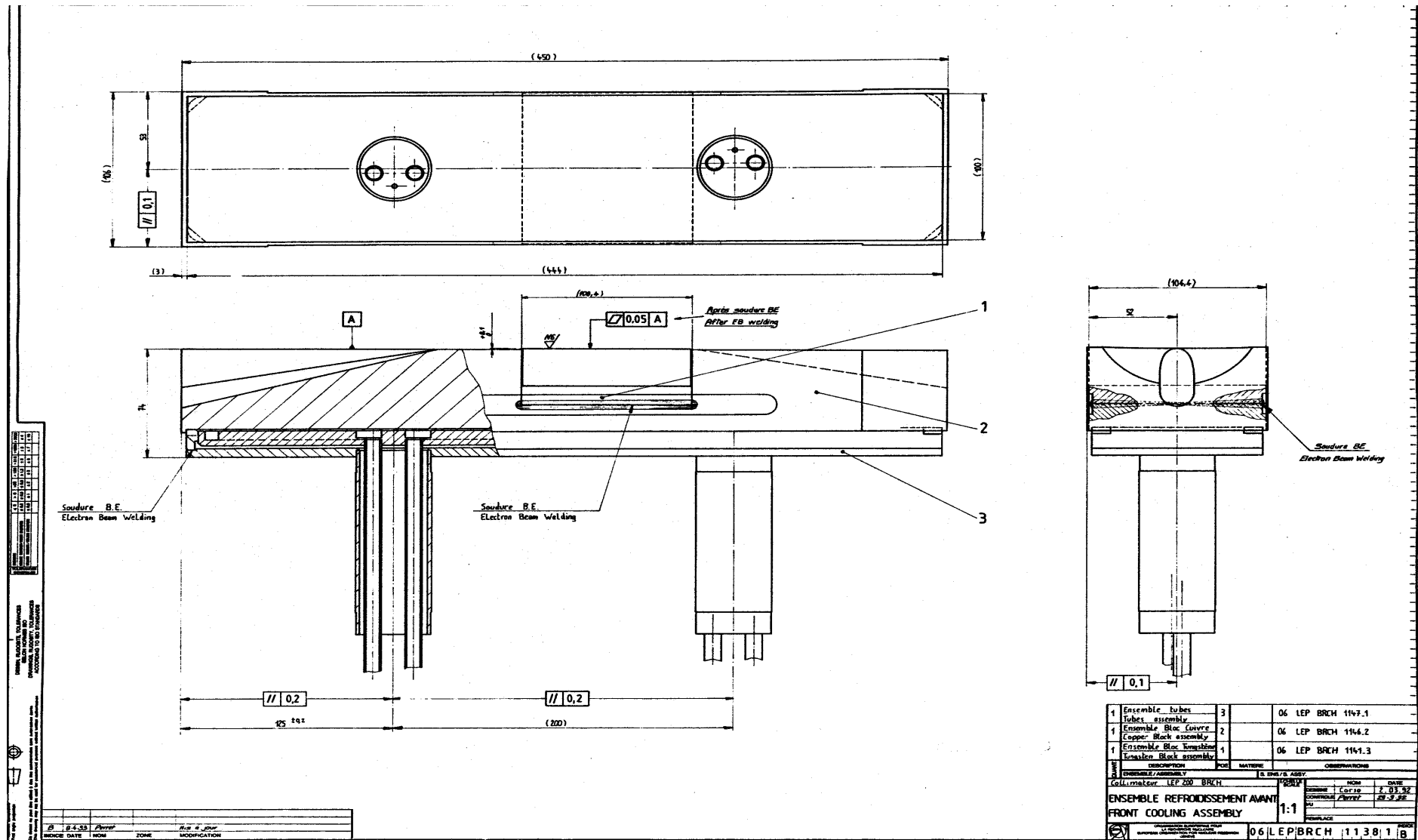


fig. 2

-3- Error contribution (δx):

- _ Jaws positioning precision wrt external reference sockets fixed on the tank.
- _ Jaw motion (motor unit + mechanical driving) & control.
- _ Thermal expansion effects.

3 Collimator in LHC tunnel.

LHC environment (from integration layout):

- 1- Comfortable situation in general: fig. 3
- 2- Critical situation at some secondary collimators (located inside Quad section): fig.4

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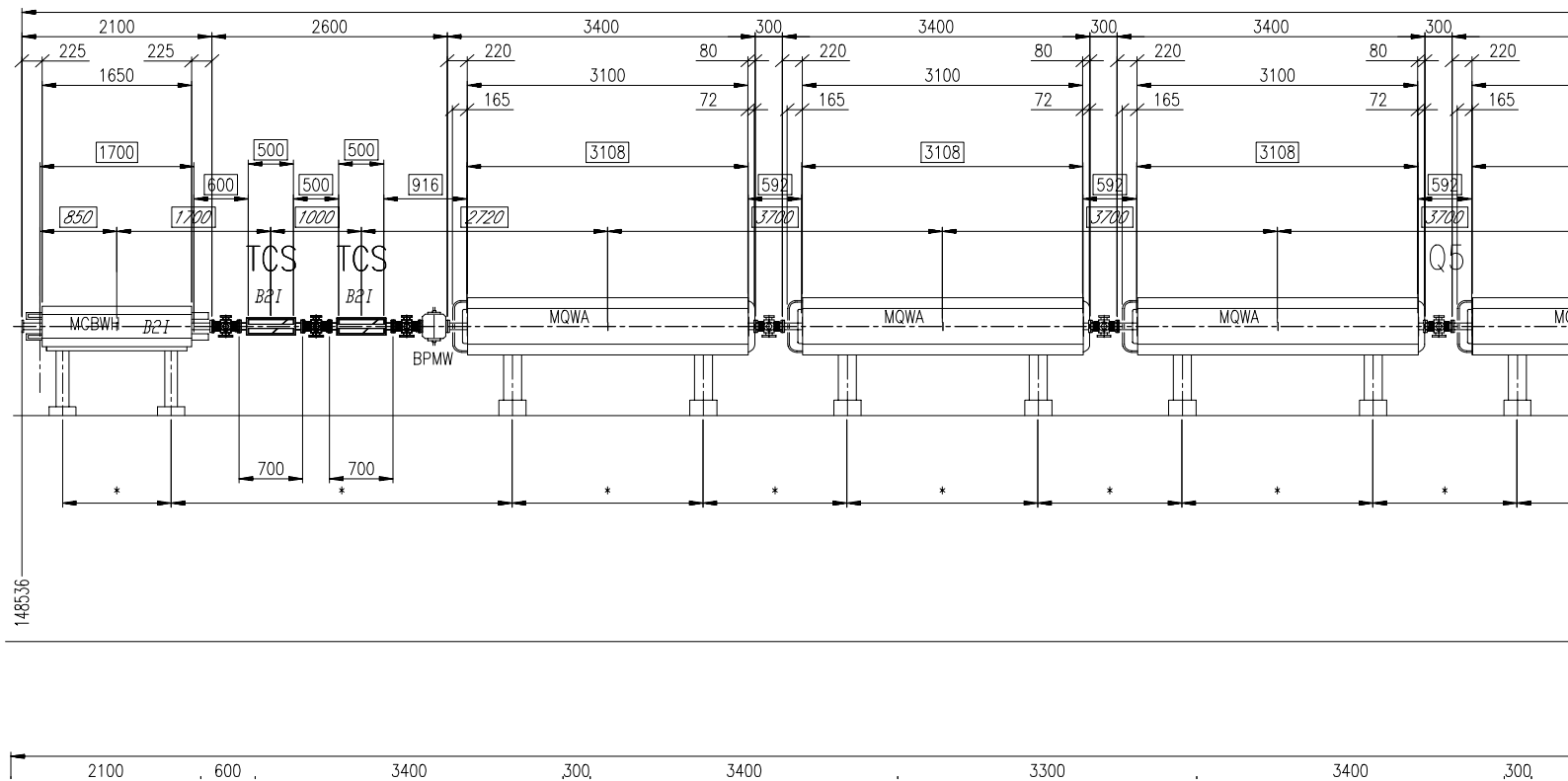
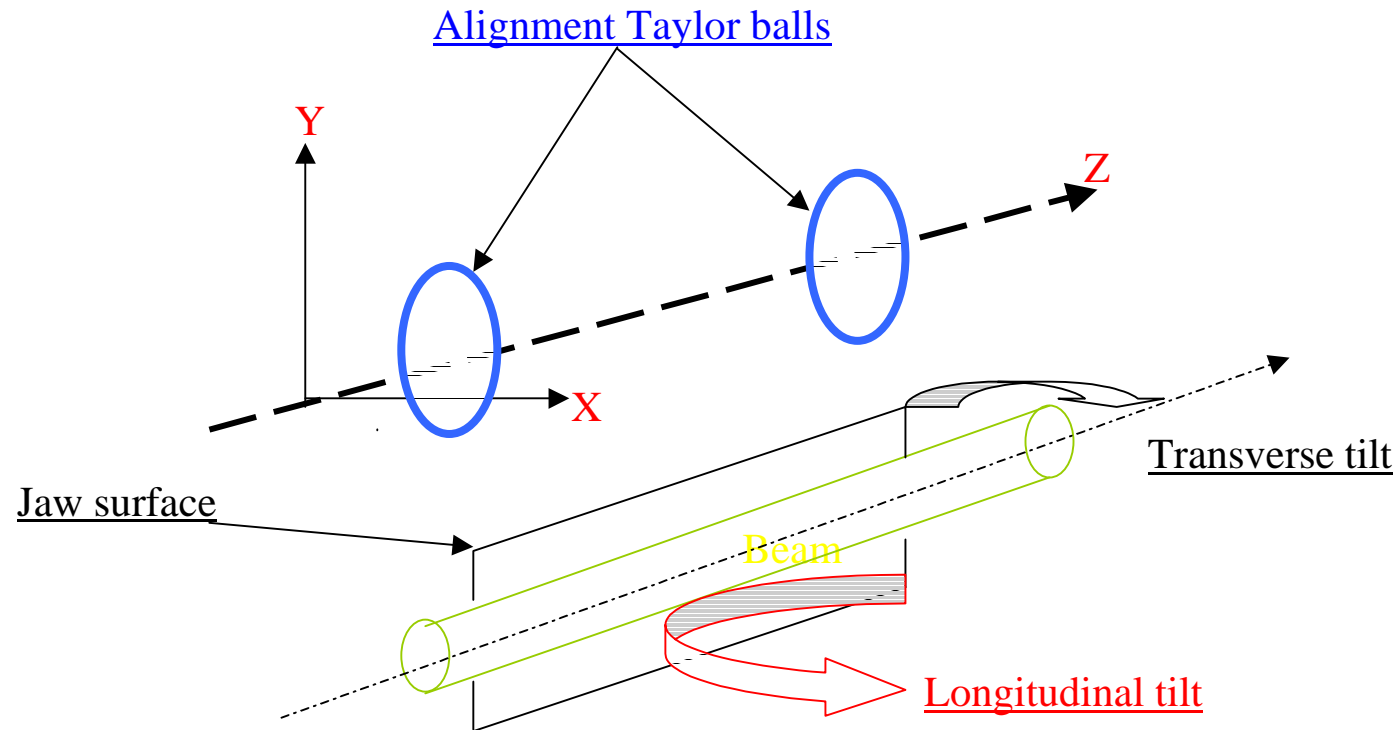


fig. 4

Alignment parameters and precisions:



- _ **Z** precision positioning is not critical (precision may be defined as $\pm 1\text{mm}$).
- _ Precision on **X** & **Y** positioning (of each Taylor ball) guarantees relative jaws position wrt local references (surrounding Quad or Dip)
- _ **Longitudinal tilt** depends on precision on **X** or **Y** or both.
- _ Collimators stability inside LHC tunnel must also be considered (ground motion...).

4 Present status of collimator studies

- 1- A collimator model is being built to investigate:
 - _ Integration components.
 - _ Transition pieces and impedance measurements.
 - _ A “scale 1” collimator for integration studies in LHC (fig. 5 & Picture1).
- 2- Due to high radiation level around collimators ($>10^5$ Gy/y):
 - _ Special components have to be selected.
 - _ Quick, precise and stable alignment mechanical system has to be provided.
 - _ A “plug and play” tank fixation will be studied (collimator failure).
- 3- Good vacuum properties are expected, but must be still specified by LHC/VAC.
- 4- Shielding and BLM configuration around collimators has to be compatible.

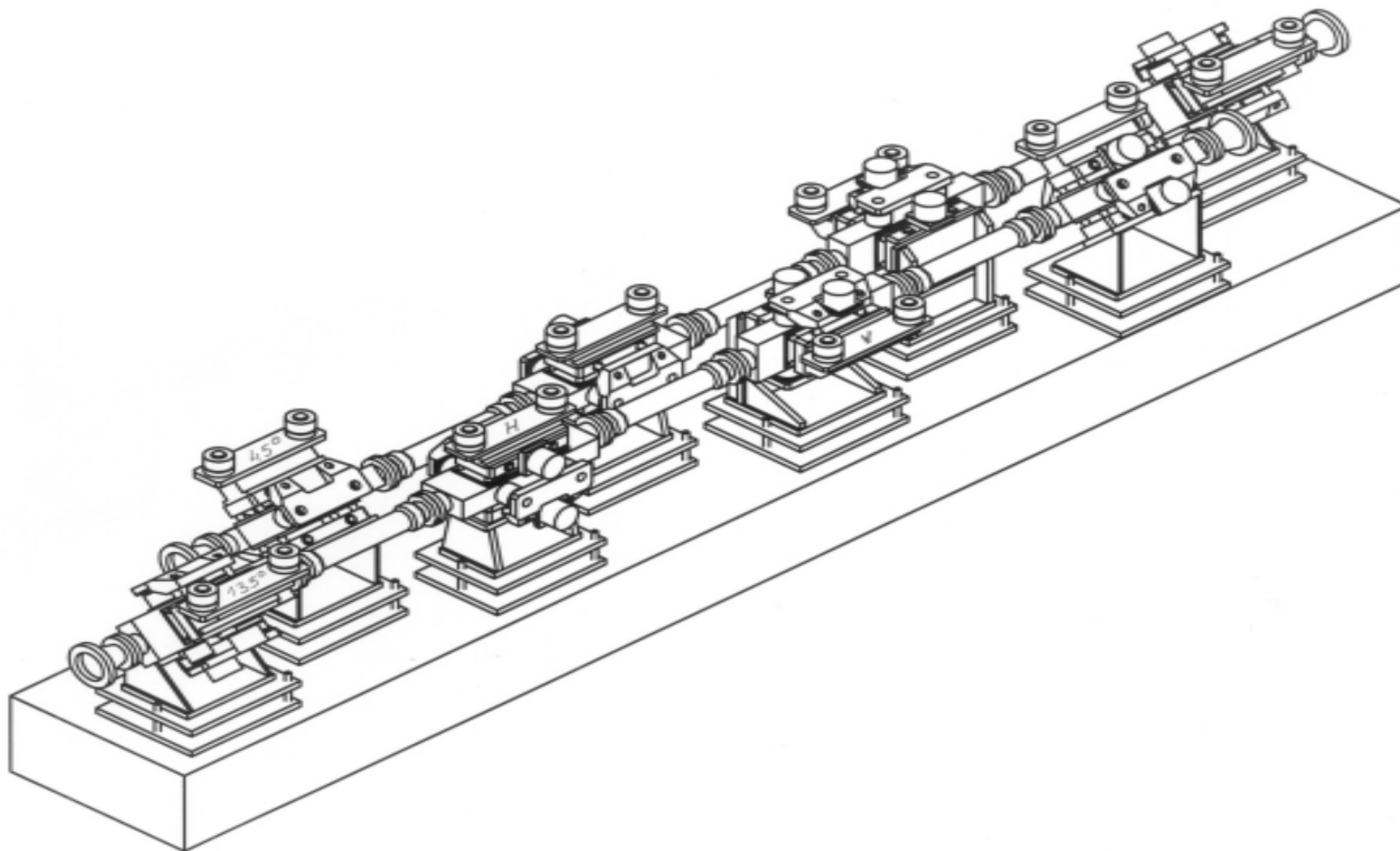
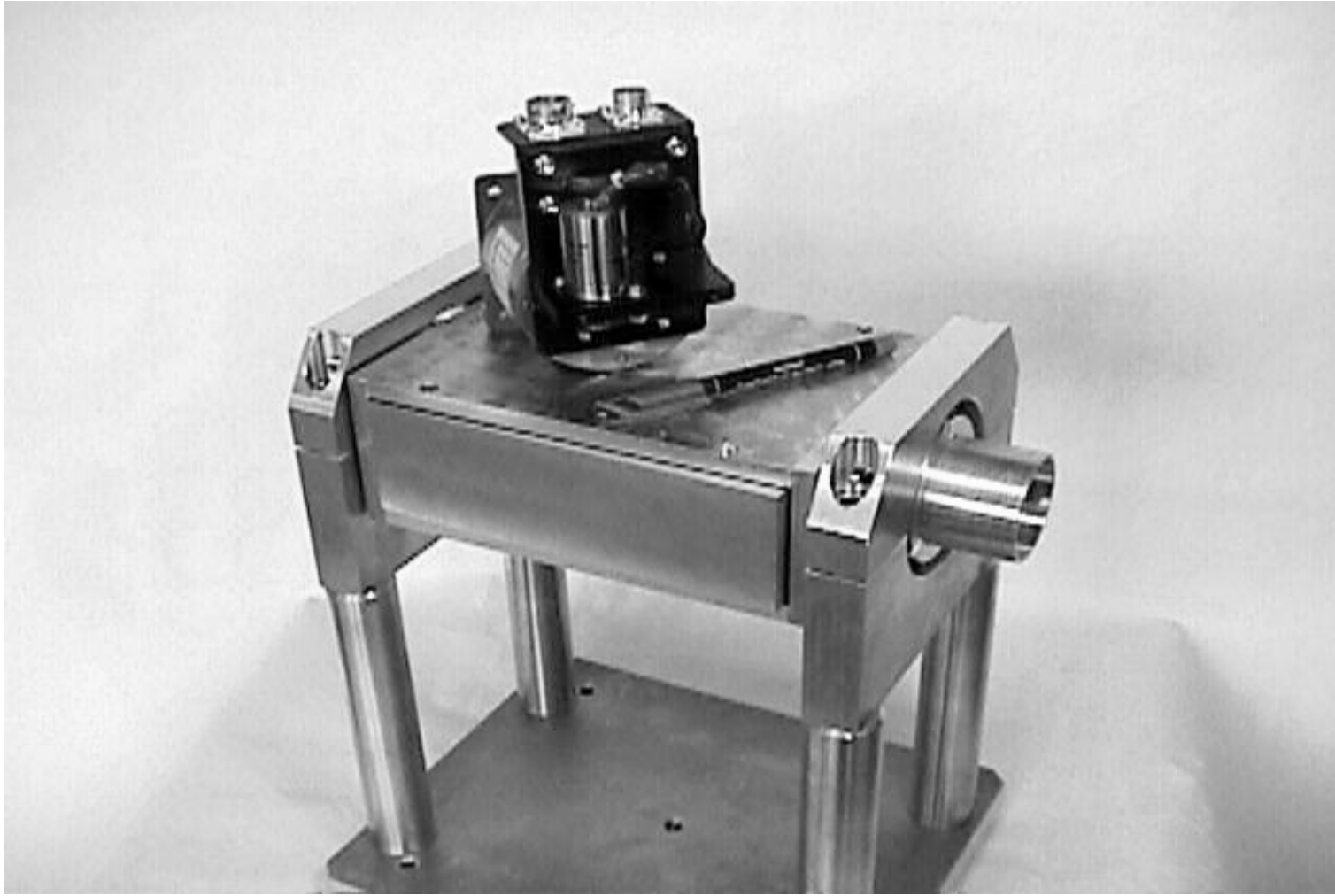


fig. 5



J. P. Bindi

Picture 1