



TEST DATA

| | | | |
|-----------------------|--------------------------|------------|------------|
| Measurement point | Relieving Heat treatment | Date | 01-00-1900 |
| Workpiece's reference | Relieving Heat treatment | Location | SINT lab |
| Customer name | 0.0 | Job number | 0 |

MATERIAL DATA

| | | | | |
|-----------------|----------|-----|-----------|----------|
| Material type | Titanium | | | |
| Young modulus | 100000.0 | ± | 5.0% | |
| Poisson's ratio | 0.32 | ± | 5.0% | |
| Yield stress | 0.0 | MPa | Thickness | 50.00 mm |

AMPLIFIER / STRAIN GAGE DETAILS

| | | | |
|----------------------|-----------------|--------------|---------------------------|
| Rosette | K-RY61-1.5/120R | Rosette type | B |
| Rosette diameter | 5.10 mm | Position | Grid A in axial direction |
| Gage factor - Grid A | 1.93 | ± | 1.5% |
| Gage factor - Grid B | 1.93 | ± | 1.5% |
| Gage factor - Grid C | 1.93 | ± | 1.5% |

HOLE DATA

| | | | |
|----------------------------|----------|----------------------------|----------|
| Total depth | 2.000 mm | Number of steps | 52 |
| Hole diameter | 1.81 mm | Hole eccentricity | 0.040 mm |
| Hole radius X ₁ | 0.91 mm | Hole radius X ₂ | 0.90 mm |
| Hole radius Y ₁ | 0.94 mm | Hole radius Y ₂ | 0.87 mm |

INSTRUMENT DATA

| | | | | | |
|-----------------------|-----------------|---------|------|---|-----|
| Hole drilling device | MTS3000-Restan | SINT n. | 640 | / | 641 |
| Strain gage amplifier | QuantumX MX440 | SINT n. | 1329 | | |
| Dial gauge | Mitutoyo 2046SB | SINT n. | 992 | / | 993 |

The measurement uncertainties stated in this document were estimated as expanded uncertainty obtained multiplying the standard uncertainty by the coverage factor k=2, that for a normal distribution, corresponding to a confidence level of about 95%.

Test Owner

0

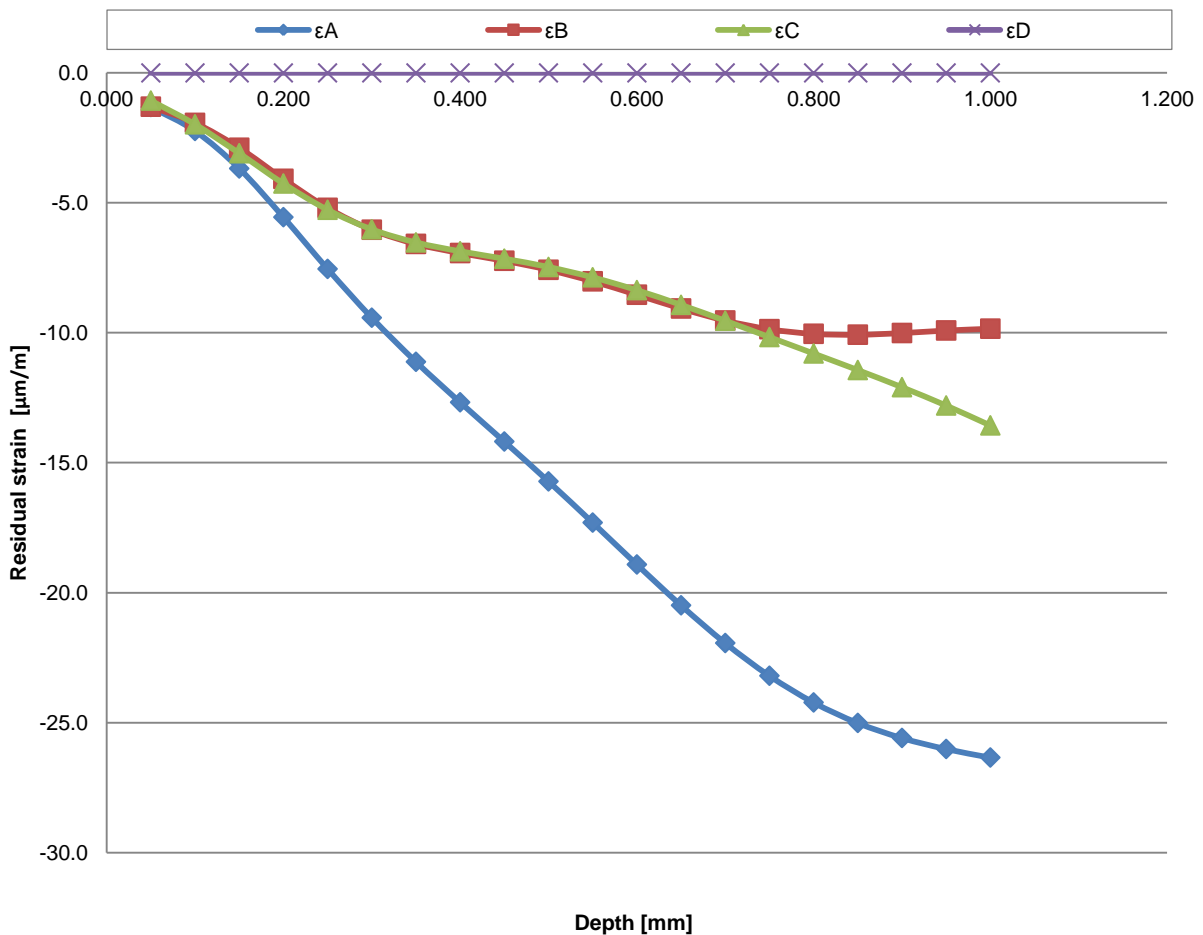
Head of Residual stress area

Ing. Alessio Benincasa



| Depth [mm] | ϵ_A [$\mu\text{m}/\text{m}$] | $\pm U \epsilon_A$ [$\mu\text{m}/\text{m}$] | ϵ_B [$\mu\text{m}/\text{m}$] | $\pm U \epsilon_B$ [$\mu\text{m}/\text{m}$] | ϵ_C [$\mu\text{m}/\text{m}$] | $\pm U \epsilon_C$ [$\mu\text{m}/\text{m}$] | ϵ_D [$\mu\text{m}/\text{m}$] | $\pm U \epsilon_D$ [$\mu\text{m}/\text{m}$] |
|------------|---|---|---|---|---|---|---|---|
| 0.050 | -1.3 | 2.6 | -1.3 | 2.6 | -1.1 | 2.6 | / | / |
| 0.100 | -2.2 | 2.6 | -1.9 | 2.6 | -2.0 | 2.6 | / | / |
| 0.150 | -3.7 | 2.6 | -2.9 | 2.6 | -3.1 | 2.6 | / | / |
| 0.200 | -5.6 | 2.6 | -4.1 | 2.6 | -4.3 | 2.6 | / | / |
| 0.250 | -7.5 | 2.6 | -5.2 | 2.6 | -5.3 | 2.6 | / | / |
| 0.300 | -9.4 | 2.6 | -6.0 | 2.6 | -6.0 | 2.6 | / | / |
| 0.350 | -11.1 | 2.6 | -6.6 | 2.6 | -6.5 | 2.6 | / | / |
| 0.400 | -12.7 | 2.6 | -6.9 | 2.6 | -6.9 | 2.6 | / | / |
| 0.450 | -14.2 | 2.6 | -7.2 | 2.6 | -7.1 | 2.6 | / | / |
| 0.500 | -15.7 | 2.6 | -7.6 | 2.6 | -7.5 | 2.6 | / | / |
| 0.550 | -17.3 | 2.6 | -8.0 | 2.6 | -7.9 | 2.6 | / | / |
| 0.600 | -18.9 | 2.6 | -8.5 | 2.6 | -8.4 | 2.6 | / | / |
| 0.650 | -20.5 | 2.7 | -9.1 | 2.6 | -8.9 | 2.6 | / | / |
| 0.700 | -21.9 | 2.7 | -9.5 | 2.6 | -9.5 | 2.6 | / | / |
| 0.750 | -23.2 | 2.7 | -9.9 | 2.6 | -10.2 | 2.6 | / | / |
| 0.800 | -24.2 | 2.7 | -10.0 | 2.6 | -10.8 | 2.6 | / | / |
| 0.850 | -25.0 | 2.7 | -10.1 | 2.6 | -11.4 | 2.6 | / | / |
| 0.900 | -25.6 | 2.7 | -10.0 | 2.6 | -12.1 | 2.6 | / | / |
| 0.950 | -26.0 | 2.7 | -9.9 | 2.6 | -12.8 | 2.6 | / | / |
| 1.000 | -26.3 | 2.7 | -9.8 | 2.6 | -13.6 | 2.6 | / | / |

| | | |
|------------------|------|----------------------------|
| D_{std}^2 | 0.00 | [$\mu\text{m}/\text{m}$] |
| σ_{std}^2 | 0.00 | [$\mu\text{m}/\text{m}$] |
| t_{std}^2 | 0.00 | [$\mu\text{m}/\text{m}$] |





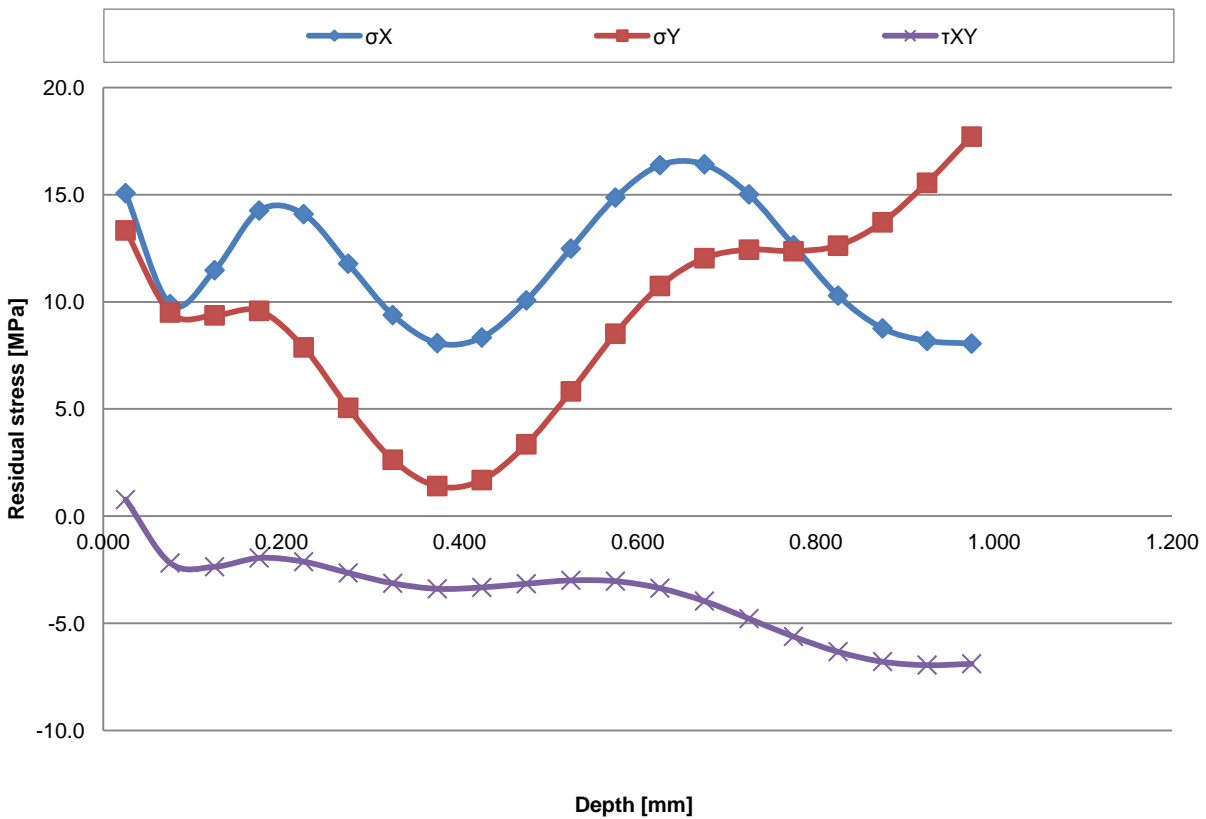
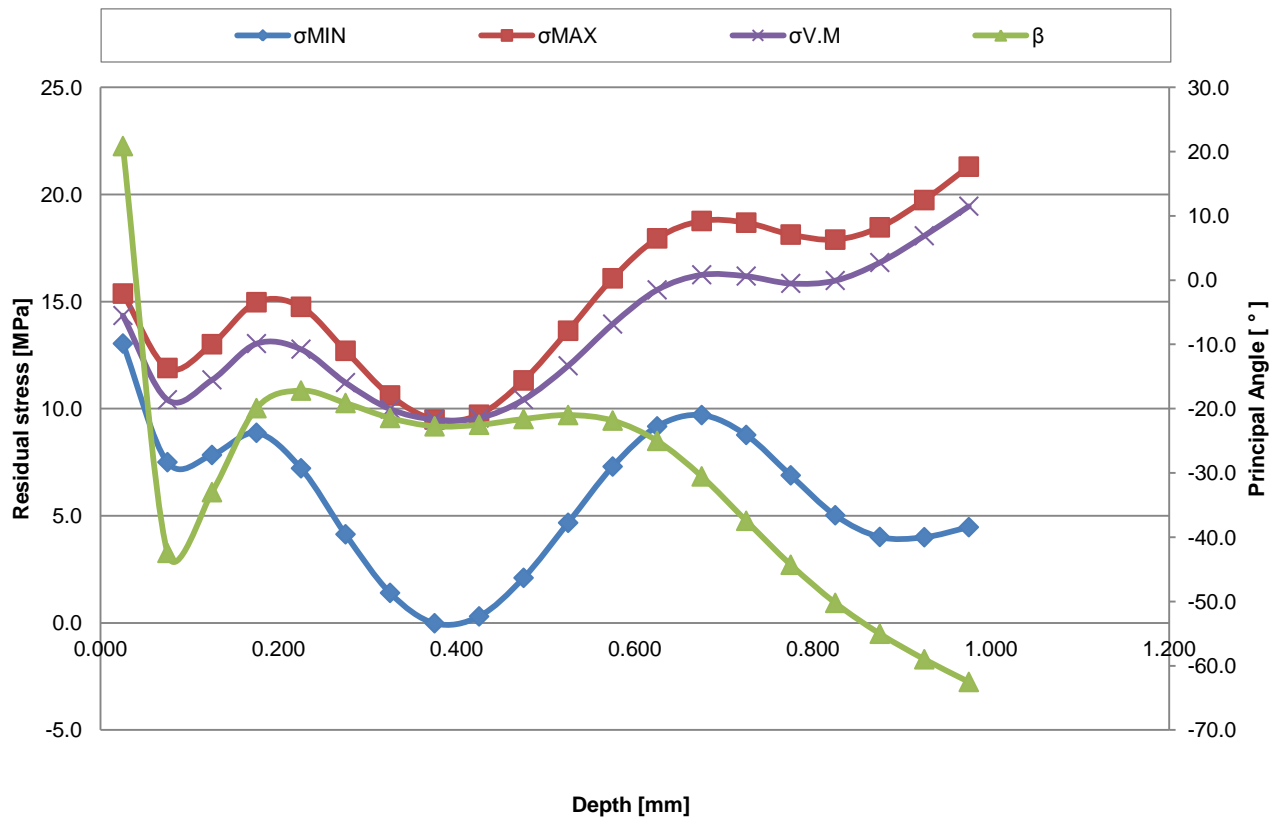
ASTM E837-13: UNIFORM STRESS

| | | | | | | | |
|----------------------|-------|---|-----|----------------------|------|---|-----|
| Type: | Blind | | | $\sigma_{V,M}$ [MPa] | 11.9 | ± | 7.8 |
| σ_{MIN} [MPa] | 7.0 | ± | 7.8 | σ_X [MPa] | 12.5 | ± | 7.9 |
| σ_{MAX} [MPa] | 13.7 | ± | 7.9 | σ_Y [MPa] | 8.1 | ± | 7.8 |
| β [°] | -24.8 | ± | 3.0 | τ_{XY} [MPa] | -2.6 | ± | 7.8 |

ASTM E837-13: NOT UNIFORM STRESS

| Depth [mm] | σ_{MIN} [MPa] | $\pm U \sigma_{MIN}$ [MPa] | σ_{MAX} [MPa] | $\pm U \sigma_{MAX}$ [MPa] | β [°] | $\pm U \beta$ [°] | $\sigma_{V,M}$ [MPa] | $\pm U \sigma_{V,M}$ [MPa] |
|------------|----------------------|----------------------------|----------------------|----------------------------|-------------|-------------------|----------------------|----------------------------|
| 0.025 | 13.0 | 7.9 | 15.4 | 7.9 | 20.9 | 2.5 | 14.3 | 7.9 |
| 0.075 | 7.5 | 7.8 | 11.9 | 7.8 | -42.4 | 5.1 | 10.4 | 7.8 |
| 0.125 | 7.8 | 7.8 | 13.0 | 7.8 | -33.0 | 4.0 | 11.3 | 7.8 |
| 0.175 | 8.9 | 7.9 | 15.0 | 7.9 | -19.9 | 2.4 | 13.0 | 7.8 |
| 0.225 | 7.2 | 7.8 | 14.8 | 7.9 | -17.2 | 2.1 | 12.8 | 7.8 |
| 0.275 | 4.1 | 7.8 | 12.7 | 7.8 | -19.1 | 2.3 | 11.2 | 7.8 |
| 0.325 | 1.4 | 7.8 | 10.6 | 7.8 | -21.4 | 2.6 | 10.0 | 7.8 |
| 0.375 | 0.0 | 7.8 | 9.5 | 7.8 | -22.7 | 2.7 | 9.5 | 7.8 |
| 0.425 | 0.3 | 7.8 | 9.7 | 7.8 | -22.5 | 2.7 | 9.6 | 7.8 |
| 0.475 | 2.1 | 7.8 | 11.3 | 7.8 | -21.6 | 2.6 | 10.4 | 7.8 |
| 0.525 | 4.7 | 7.8 | 13.6 | 7.9 | -21.0 | 2.5 | 12.0 | 7.8 |
| 0.575 | 7.3 | 7.8 | 16.1 | 7.9 | -21.8 | 2.6 | 14.0 | 7.9 |
| 0.625 | 9.2 | 7.9 | 18.0 | 7.9 | -25.0 | 3.0 | 15.5 | 7.9 |
| 0.675 | 9.7 | 7.9 | 18.8 | 7.9 | -30.5 | 3.7 | 16.3 | 7.9 |
| 0.725 | 8.8 | 7.9 | 18.7 | 7.9 | -37.4 | 4.5 | 16.2 | 7.9 |
| 0.775 | 6.9 | 7.8 | 18.1 | 7.9 | -44.3 | 5.3 | 15.8 | 7.9 |
| 0.825 | 5.0 | 7.8 | 17.9 | 7.9 | -50.2 | 6.0 | 16.0 | 7.9 |
| 0.875 | 4.0 | 7.8 | 18.5 | 7.9 | -55.0 | 6.6 | 16.8 | 7.9 |
| 0.925 | 4.0 | 7.8 | 19.7 | 7.9 | -59.0 | 7.1 | 18.1 | 7.9 |
| 0.975 | 4.5 | 7.8 | 21.3 | 7.9 | -62.5 | 7.5 | 19.5 | 7.9 |

| Depth [mm] | σ_X [MPa] | $\pm U \sigma_X$ [MPa] | σ_Y [MPa] | $\pm U \sigma_Y$ [MPa] | τ_{XY} [MPa] | $\pm U \tau_{XY}$ [MPa] |
|------------|------------------|------------------------|------------------|------------------------|-------------------|-------------------------|
| 0.025 | 15.1 | 7.9 | 13.3 | 7.9 | 0.8 | 7.8 |
| 0.075 | 9.9 | 7.8 | 9.5 | 7.8 | -2.2 | 7.8 |
| 0.125 | 11.5 | 7.9 | 9.4 | 7.8 | -2.4 | 7.8 |
| 0.175 | 14.3 | 7.9 | 9.6 | 7.8 | -2.0 | 7.8 |
| 0.225 | 14.1 | 7.9 | 7.9 | 7.8 | -2.1 | 7.8 |
| 0.275 | 11.8 | 7.9 | 5.1 | 7.8 | -2.7 | 7.8 |
| 0.325 | 9.4 | 7.8 | 2.6 | 7.8 | -3.1 | 7.8 |
| 0.375 | 8.1 | 7.8 | 1.4 | 7.8 | -3.4 | 7.8 |
| 0.425 | 8.3 | 7.8 | 1.7 | 7.8 | -3.3 | 7.8 |
| 0.475 | 10.1 | 7.8 | 3.4 | 7.8 | -3.2 | 7.8 |
| 0.525 | 12.5 | 7.9 | 5.8 | 7.8 | -3.0 | 7.8 |
| 0.575 | 14.9 | 7.9 | 8.5 | 7.8 | -3.0 | 7.8 |
| 0.625 | 16.4 | 7.9 | 10.7 | 7.8 | -3.4 | 7.8 |
| 0.675 | 16.4 | 7.9 | 12.0 | 7.8 | -4.0 | 7.8 |
| 0.725 | 15.0 | 7.9 | 12.4 | 7.8 | -4.8 | 7.8 |
| 0.775 | 12.6 | 7.9 | 12.4 | 7.8 | -5.6 | 7.9 |
| 0.825 | 10.3 | 7.8 | 12.6 | 7.8 | -6.3 | 7.9 |
| 0.875 | 8.8 | 7.8 | 13.7 | 7.9 | -6.8 | 7.9 |
| 0.925 | 8.2 | 7.8 | 15.6 | 7.9 | -7.0 | 7.9 |
| 0.975 | 8.1 | 7.8 | 17.7 | 7.9 | -6.9 | 7.9 |



NOTE Several computed stresses significantly exceed 80 % of the material yield stress, then the results are considered as indicative only. In general, the computed stresses whose values exceed 80 % of the material yield stress tend to be overestimated.