

Resultados de la calibración  
(Calibration results)

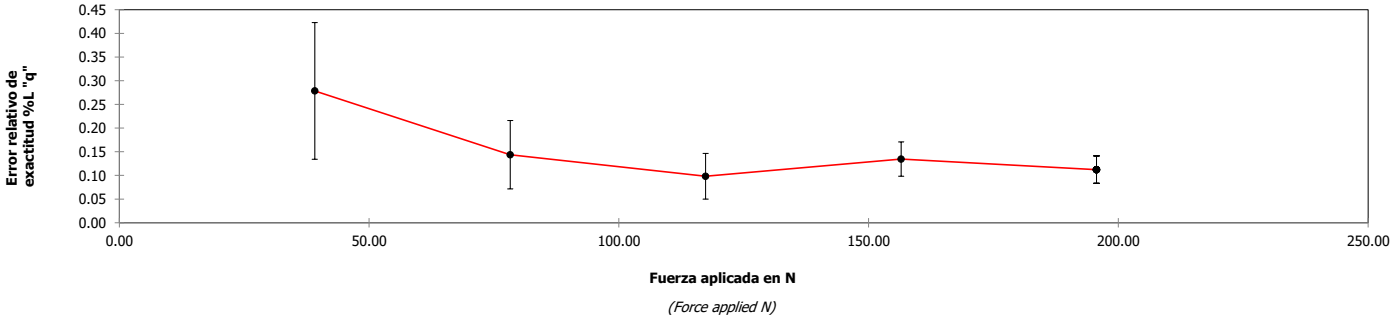
|                             |          |
|-----------------------------|----------|
| Sentido:<br>(Sense)         | Tracción |
| Resolución:<br>(Resolution) | 0.01 kgf |

| Fuerza aplicada (patrón)<br>(Applied force (standard)) |        | Lecturas de equipo bajo calibración (IBC)<br>(Equipment readings under calibration) |                                      |                                      |                       |         |
|--------------------------------------------------------|--------|-------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|-----------------------|---------|
| N                                                      | kgf    | 1ª serie<br>0° Ascenso<br>(Ascent)                                                  | 2ª serie<br>120° Ascenso<br>(Ascent) | 3ª serie<br>240° Ascenso<br>(Ascent) | Promedio<br>(Average) |         |
|                                                        |        | kgf                                                                                 | kgf                                  | kgf                                  | kgf                   | N       |
| 39.118                                                 | 3.989  | 4.000                                                                               | 4.000                                | 4.000                                | 4.000                 | 39.227  |
| 78.243                                                 | 7.979  | 7.990                                                                               | 7.990                                | 7.990                                | 7.990                 | 78.355  |
| 117.368                                                | 11.968 | 11.980                                                                              | 11.980                               | 11.980                               | 11.980                | 117.484 |
| 156.500                                                | 15.959 | 15.980                                                                              | 15.980                               | 15.980                               | 15.980                | 156.710 |
| 195.619                                                | 19.948 | 19.970                                                                              | 19.970                               | 19.970                               | 19.970                | 195.839 |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |

| Fuerza aplicada<br>(patrón)<br>(Applied force<br>(standard)) | IBC Promedio<br>(Average) | Error relativo de<br>repetibilidad<br>(Repeatability<br>relative error)<br>"b" | Error relativo de exactitud<br>(Relative accuracy error)<br>"q" |       | Incertidumbre de medida<br>(Measurement uncertainty) |         |
|--------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------|-------|------------------------------------------------------|---------|
| N                                                            | N                         | %L                                                                             | %L                                                              | N     | %L                                                   | N       |
| 39.118                                                       | 39.227                    | 0.000                                                                          | 0.278                                                           | 0.109 | 1.4E-01                                              | 5.6E-02 |
| 78.243                                                       | 78.355                    | 0.000                                                                          | 0.144                                                           | 0.112 | 7.2E-02                                              | 5.7E-02 |
| 117.368                                                      | 117.484                   | 0.000                                                                          | 0.098                                                           | 0.115 | 4.8E-02                                              | 5.7E-02 |
| 156.500                                                      | 156.710                   | 0.000                                                                          | 0.134                                                           | 0.210 | 3.6E-02                                              | 5.7E-02 |
| 195.619                                                      | 195.839                   | 0.000                                                                          | 0.112                                                           | 0.220 | 2.9E-02                                              | 5.7E-02 |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |

|                                     |             |
|-------------------------------------|-------------|
| Error de cero (fo):<br>(Zero error) | 0.0E+00 % L |
|-------------------------------------|-------------|

Gráfica del error relativo de exactitud (Tracción)  
(Graph of relative accuracy error (Traction))



Requerimientos del cliente:  
(Customer requirements)  
  
Sin requerimientos.

Resultados de la calibración  
(Calibration results)

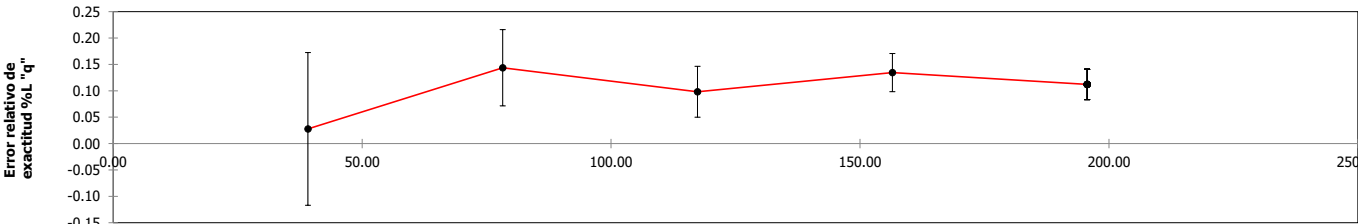
|                             |            |
|-----------------------------|------------|
| Sentido:<br>(Sense)         | Compresión |
| Resolución:<br>(Resolution) | 0.01 kgf   |

| Fuerza aplicada (patrón)<br>(Applied force (standard)) |        | Lecturas de equipo bajo calibración (IBC)<br>(Equipment readings under calibration) |                                      |                                      |                       |         |
|--------------------------------------------------------|--------|-------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|-----------------------|---------|
| N                                                      | kgf    | 1ª serie<br>0° Ascenso<br>(Ascent)                                                  | 2ª serie<br>120° Ascenso<br>(Ascent) | 3ª serie<br>240° Ascenso<br>(Ascent) | Promedio<br>(Average) |         |
|                                                        |        | kgf                                                                                 | kgf                                  | kgf                                  | kgf                   | N       |
| 39.118                                                 | 3.989  | 3.990                                                                               | 3.990                                | 3.990                                | 3.990                 | 39.129  |
| 78.243                                                 | 7.979  | 7.990                                                                               | 7.990                                | 7.990                                | 7.990                 | 78.355  |
| 117.368                                                | 11.968 | 11.980                                                                              | 11.980                               | 11.980                               | 11.980                | 117.484 |
| 156.500                                                | 15.959 | 15.980                                                                              | 15.980                               | 15.980                               | 15.980                | 156.710 |
| 195.619                                                | 19.948 | 19.970                                                                              | 19.970                               | 19.970                               | 19.970                | 195.839 |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |
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| ---                                                    | ---    | ---                                                                                 | ---                                  | ---                                  | ---                   | ---     |

| Fuerza aplicada<br>(patrón)<br>(Applied force<br>(standard)) | IBC Promedio<br>(Average) | Error relativo de<br>repetibilidad<br>(Repeatability<br>relative error)<br>"b" | Error relativo de exactitud<br>(Relative accuracy error)<br>"q" |       | Incertidumbre de medida<br>(Measurement uncertainty) |         |
|--------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------|-------|------------------------------------------------------|---------|
| N                                                            | N                         | %L                                                                             | %L                                                              | N     | %L                                                   | N       |
| 39.118                                                       | 39.129                    | 0.000                                                                          | 0.028                                                           | 0.011 | 1.4E-01                                              | 5.7E-02 |
| 78.243                                                       | 78.355                    | 0.000                                                                          | 0.144                                                           | 0.112 | 7.2E-02                                              | 5.7E-02 |
| 117.368                                                      | 117.484                   | 0.000                                                                          | 0.098                                                           | 0.115 | 4.8E-02                                              | 5.7E-02 |
| 156.500                                                      | 156.710                   | 0.000                                                                          | 0.134                                                           | 0.210 | 3.6E-02                                              | 5.7E-02 |
| 195.619                                                      | 195.839                   | 0.000                                                                          | 0.112                                                           | 0.220 | 2.9E-02                                              | 5.7E-02 |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |
| ---                                                          | ---                       | ---                                                                            | ---                                                             | ---   | ---                                                  | ---     |

|                                     |             |
|-------------------------------------|-------------|
| Error de cero (fo):<br>(Zero error) | 0.0E+00 % L |
|-------------------------------------|-------------|

Gráfica del error relativo de exactitud (Compresión)  
(Graph of relative accuracy error (Compression))



Fuerza aplicada en N  
(Force applied N)

Requerimientos del cliente:  
(Customer requirements)  
  
Sin requerimientos.

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## Observaciones generales

(General observations)

- Es responsabilidad del usuario establecer la fecha de recalibración del equipo. El tiempo y validez de los resultados informados en este documento depende de las características propias del equipo, de las condiciones de operación y de las buenas practicas de uso y cuidado.

(It is the responsibility of the user to set the recalibration date of his/her equipment. The time and validity of the results reported in this document depends on the characteristics of the equipment, the operating conditions and good use and care practices)

- El uso de los resultados de la calibración queda a consideración del usuario.

(The use of calibration results is the responsibility of the user)

- Los resultados y niveles de incertidumbres declarados en este certificado de calibración corresponden exclusivamente al instrumento descrito en la hoja 1.

(The results and uncertainty levels declared in this calibration certificate correspond exclusively to the instrument described in sheet 1)

- Los resultados que se presentan en este certificado tienen trazabilidad a patrones nacionales.

(The results presented in this certificate have traceability to national standards)

- La incertidumbre expandida se expresa con un factor de cobertura de  $k=2$ , que asegura un nivel de confianza de al menos 95 % aproximadamente.

(The expanded uncertainty is expressed by a coverage factor of  $k=2$ , which assures the confidence level of less than about 95 %)

- La incertidumbre de medida fue estimada según la NMX-CH-140-IMNC-2002 "Guía para la expresión de la incertidumbre en las mediciones".

(The uncertainty of the measurement was estimated according to the NMX-CH-140-IMNC-2002 "Guide for the expression of uncertainty in the measurements")

- Las barras de error mostradas en el gráfico, representan la incertidumbre de medida ( $U_{k=2}$ ) de cada punto de calibración.

(The error bars shown in the graph represent the measurement uncertainty ( $U_{k=2}$ ) of each calibration point)

## Descripción del método:

(Description of method)

- La lectura promedio para cada punto calibrado se obtiene promediando las 3 series.

(The average reading for each calibrated point is obtained by averaging 3 series)

- El error relativo de exactitud se obtiene de la diferencia entre el valor de la lectura del IBC y la fuerza aplicada, entre la fuerza aplicada, multiplicado por 100.

(The relative accuracy error is obtained from the difference between the IBC reading value and the applied force, between the applied force multiplied by 100)

- El método de medición es la medición directa de los transductores de fuerza o apilamiento de masas, colocados en serie con el IBC.

(The measurement method is the direct measurement of force transducers or mass stacking, placed in series with the IBC)

- El instrumento o máquina bajo calibración es instalado junto con el patrón de fuerza al menos 2 h para su ambientación antes del inicio de la toma de datos para la calibración. Se realizan pruebas preliminares de funcionamiento al equipo por calibrar. Se aplican tres fuerzas al 100% del intervalo de medición (precargas) para la estabilización y acomodamiento de la estructura interna del elemento elástico del sensor. Una vez hecho lo anterior se aplican fuerzas en el sentido de la calibración (tracción y/o compresión) dividiendo el intervalo de medición en cinco puntos equidistantes distribuidos dentro del intervalo de medición. Cada paso de carga del intervalo de medición es medido una vez en cada posición de montaje de referencia (0°, 120° y 240°) y en forma creciente. Al finalizar cada serie cuando se descarga la fuerza se toma la lectura a los 30 s para el calculo de error relativo de cero.

(The instrument or machine under calibration is installed together with the force standard at least 2 h for its setting before the start of data collection for calibration. Preliminary tests are performed on the equipment to be calibrated. Three forces are applied at 100% of the measurement range (preloads) for stabilization and accommodation of the internal structure of the elastic sensor element. Once this has been done, forces are applied in the direction of calibration (tension and / or compression) dividing the measurement interval into five equidistant points distributed within the measurement interval. Each loading step of the measuring range is measured once at each reference mounting position (0 °, 120 ° and 240 °) and in increasing order. At the end of each series when the force is discharged, the reading is taken after 30 s for the calculation of relative error of zero)

- Norma de Referencia: NMX-CH-7500-1-IMNC-2008 / ISO 7500-1:2004

(Reference Standard: NMX-CH-7500-1-IMNC-2008 / ISO 7500-1:2004 )

- Para equipos con escala analógica, la resolución se obtuvo determinando la relación existente entre el ancho de la aguja y la distancia centro a centro entre dos marcas adyacentes de la graduación de la escala.

(For equipment with an analog scale, the resolution was obtained by determining the relationship between the width of the pointer and the center-to-center distance between two adjacent marks on the scale graduation)