Testing and Calibration in Assembly Technology
Testing and Calibration Services

By offering accredited calibration service for torque transducers and angle encoder, transducerized power tools, and torque wrenches, Atlas Copco has earned a unique position among tool manufacturers.

The Company’s accredited calibration laboratories are all accredited to ISO/IEC17025, the test and calibration laboratory quality standard. This implies a high level of technical competence and well documented, traceable calibrations. It is thus assured that the calibration services offered are in compliance with ISO 9000 and ISO/TS 16949.

In addition to the accredited services, the laboratories offer simplified factory calibration of measuring equipment and verification of tools. On-site calibration and process capability measurements are also offered.

Atlas Copco has accredited facilities in Europe (Germany and Italy), North America (US) and South America (Brazil) to service industrial markets.

The addresses of Atlas Copco calibration laboratories can be found on the inside back cover of this Guide.
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1. Introduction

The purpose of this pocket guide is to give the reader:

- An understanding of commonly used terms in the context of testing assembly tools;
- An understanding of the importance of regular calibration of measuring equipment used for assuring the correct result in assembly operations.

Study this typical assembly operation. The steering mechanism of the front wheel is tightened with a Tensor, a transducerized electric tool. Imagine what the consequences could be if the joint was not properly tightened. In order to assure a correct tightening the tools must be tested at regular intervals.

Fig. 1. Actual assembly operation.
2. Testing

Testing is the method of determining to what extent a requirement, such as the function or accuracy of a measuring device, is fulfilled.

2.1 What do we mean by testing?
Testing a tool means checking that it performs within prescribed tolerance limits.

Characteristics tested include, for example:

- Capability to reach maximum and minimum torque
- Accuracy (torque trueness and scatter)
- Idling speed
- Durability

All Atlas Copco tools are tested prior to delivery when the first three characteristics are tested. Many other tests are carried out during the development of the tools, for example durability and maximum duty cycle.

However, a tool must also be tested regularly throughout its entire life. Some tests can be carried out by the tool user, others require equipment that is normally only found in the manufacturer’s laboratory.
2.2 Why is testing important?
All tools are subject to mechanical stress, e.g., gears, bearings and motors are subject to wear. As a result, a tool may not deliver its expected torque or may not be as accurate as expected. The consequences are obvious. Nuts and screws may not be tightened to the prescribed torque, joints may fail, some may even cause injuries. To avoid this, tools need regular testing.

2.3 Measuring equipment
In order to test we must measure. When we test tools we use various kinds of measuring equipment. To be reliable, all measuring devices need to be calibrated at regular intervals. When we discuss tightening, the most important measuring device is the torque transducer.

Fig. 3. Equipment for testing an assembly tool.

20.3
3. Tolerances and torque scatter

3.1 What are precision, trueness and accuracy?

Precision refers to the closeness between a series of test values. Good precision is illustrated in figure 4.1. A large scatter leads to bad precision. The machine capability index $C_m$ is often used as a measure of precision. Good precision implies a large value of $C_m$. Bad precision calls for tool service.

Good precision does not necessarily mean good trueness. Trueness refers to the closeness of agreement between the mean of a large number of test values and the reference value. Bad trueness (4.1) can be corrected by an adjustment, see 4.3. Figures 4.2 and 4.3 illustrate good trueness. For these two cases adjustment is not needed.

Accuracy means the closeness between the individual test values and the reference value. Good accuracy means that all test values are close to the reference value. In the machine capability index $C_{mk}$ both the precision and the trueness are taken into account. Good accuracy implies a large value of $C_{mk}$.

The different measures are described in more detail in the Atlas Copco “Pocket guide to statistical analysis techniques”.

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Fig. 4.1  Fig. 4.2  Fig. 4.3
3.2 What do we mean by tolerance?
Tolerance defines the range of acceptable values. It is defined as the difference between the upper and lower permissible value.

The tolerance of power tools’ torque scatter is often stated in terms of the permissible standard deviation. For example, Class B in the Ford certification program requires that the level 6 standard deviation shall be less than 10%.

The tolerance of the application defines the requirements for tool capability. E.g. most motor vehicle manufacturers use tolerance classes for applying torque on different types of joints. Safety critical joints may demand 5% tolerance for 6s, quality critical joints 10%. The 6s range is usually expressed as a percent of the mean torque.

3.3 Measuring torque scatter (precision)
One of the most important parameters to test is the tool’s torque scatter, the precision of the tool. This is often expressed as a measurement of the tool torque capability, $C_m$.

Fig. 5. Set-up for measuring torque scatter.
This test is often carried out according to the international standard ISO 5393 “Rotary tools for threaded fasteners – Performance test method”. The tool is tested on a hard and a soft joint. A total of 25 tightenings are carried out for each joint, mostly with a high and a low torque setting and the standard deviation (torque scatter) is calculated for each combination.

To verify that the tool type is capable of fulfilling the requirements of the application, a more comprehensive capability test is often carried out on some representative samples, typically three or four different tools. Examples of this are the homologation, in German and French speaking countries, and the American Ford power tool certification program. The German VDI/VDE 2647 test procedure and the Ford test are based on the ISO 5393 performance test method.

<table>
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<td>D</td>
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<td>E</td>
<td>25 %</td>
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</table>

Table 1. Tolerance approval rating of torque scatter according to Ford Power Tool Certification Program
4. Calibration, adjustment and traceability

4.1 What is calibration?
When a measuring device is calibrated, the relationship between the input and output variables is determined and documented under the given conditions. The input variable is the physical variable to be measured – for example, torque or angle. The output variable is often the electrical output signal of the measuring device, but it can also be a reading value from the display.

Expressed in simpler terms, this means that we compare two values, one from the object we measure and the other from a reference. If these two values differ, the equipment may need an adjustment or service.

Example: When you calibrate a scale you put on a weight with known mass. If the mass is 2 kg and the scale shows 2.3 kg there is a difference and the scale needs to be adjusted in order to show the correct value.

4.2 Why is calibration important?
Many joints in the automotive industry require documentation. This means that the tightening results, as displayed on the tool controller, are documented. In order to verify that the documented torque values are true the tool has to be measured against a reference at regular intervals.

4.3 What is adjustment?
If the trueness of measured values is bad, i.e., if the mean of the measured values lies outside the permissible tolerance, an adjustment is needed. The adjusting process permanently changes the setting of the measuring device. After an adjustment a new calibration is needed.
E.g., when a transducerized tool is adjusted, the internal calibration value of the tool is changed.

The following flow chart shows a typical calibration process, including adjustment of the calibration object.

![Flow chart showing calibration and adjustment process](image-url)

Fig. 8. Calibration and adjustment overview.
4.4 What is traceability?

The word traceability is often used in connection with assembly operations with transducerized assembly tools. It is required that the torque values we read are traceable to a national standard for torque.

*Traceability describes a process in which the reading of a measuring device can be compared in one or more steps with the national standard for that particular value. For every step, a measuring system is compared with a standard that, for its part, has been calibrated with the standard of a higher level, see figure “The traceability chain”.*

![Fig. 7. The traceability chain.](image)

In the case of the transducerized assembly tool we can establish a measurement chain back to a national standard.

1. The tool is checked against a torque transducer, an IRTT.
2. The IRTT is calibrated with dead weight measuring equipment.
3. The masses of the dead weight equipment are calibrated against a national standard for weight.
4. The arms of the dead weight measuring equipment are calibrated against a national standard for length.
4.5 Tool calibration

Transducerized tools must be tested regularly in order to establish continued trueness of the delivered torque. Thus, it must be checked that the tool controller reading agrees with the reading of a torque reference transducer. This operation is often called tool calibration. It is based on a certain number of readings, generally at least 25. The average discrepancy between the tool and the reference must lie within tolerance. If not, an adjustment must be made.

![Image of tool calibration setup]

A tool calibration is a comparison measurement, referred to in German as “Vergleichsmessung”.

4.6 Controller calibration

When a transducerized power tool is used, it is connected to a controller which runs and monitors the tool. The controller is part of a measuring system and must be calibrated to maintain accurate tool operation. The controller must be calibrated both on a regular basis and following a service, when parts which may influence the torque measurement have been exchanged. The calibration of the controller is performed with a traceable calibrated reference box, which simulates a reference torque, with which the traceability is maintained. (This is valid for analogue controllers such as the Power Focus 3000).
4.7 Calibration intervals

Tools equipped with transducers must be calibrated regularly, and always after maintenance is performed. The angle encoders should also be checked when the tool is calibrated. It is not possible to state a specific interval between calibrations. A tool is calibrated in connection with service or, at minimum, annually. The interval depends on the tool model, tool usage, the relative torque level, the joint rate, and the presence of prevailing torque.

For the Power Focus, Atlas Copco recommends calibration at least once a year. It must also be calibrated following a service, when any parts which may influence torque measurement have been exchanged (e.g., the Control Card).
5. What is uncertainty?

All measurements are subject to uncertainty. The uncertainty depends on the measurement process and the measuring device. When we make a reading of the torque on a measuring device or a Power Focus controller the measured value is subject to an uncertainty. The larger the uncertainty, the less we can trust the measured value.

Measurement uncertainty is a measure of the precision of a measuring device under operating conditions. Measurement uncertainty serves as a guide in deciding whether or not a measuring device can provide the required accuracy.

Let us take an example. Assume that the upper and lower tolerance limits of a tightening are 105 Nm and 95 Nm. If it has been established that the measurement uncertainty is 2 Nm we cannot accept measured values larger than 103 Nm or lower than 97 Nm.

![Fig. 10. Visualization of tolerance band with consideration of measurement uncertainty.](image-url)
6. Accredited calibration

6.1 Demands for accredited calibration

Anyone can perform a calibration. However, many companies require that calibrations must be carried out by accredited laboratories. This requirement is, in turn, based on a requirement in the quality system used by the company, mostly ISO 9000 or, for automotive companies, the TECHNICAL SPECIFICATION ISO/TS 16949.

The ISO 9000 standard does not explicitly demand accredited calibration of measurement equipment. It is stated that the measurement equipment shall be calibrated against standards traceable to national or international standards. As a guide it is also stated that an external laboratory shall demonstrate technical competence such as defined in ISO/IEC 17025. When the customer utilizes an accredited laboratory he achieves a traceable calibration carried out by a laboratory in compliance with ISO/IEC 17025. Thereby compliance with ISO 9000 is obtained.

A relevant text in ISO/TS 16949 is:

- There shall be evidence that the external laboratory (in the eyes of a customer an Atlas Copco calibration laboratory is an external laboratory) is acceptable to the customer, or
- The laboratory shall be accredited to ISO/IEC 17025, or national equivalent.

Fig. 11. Calibration rig for torque measuring equipment.
6.2 What is an accredited laboratory?
An accredited laboratory is one which conducts calibrations according to defined standards by means of validated measuring processes. A statement of traceability of the measuring equipment in use to the national standard as well as an indication of measurement uncertainty is mandatory.

An accredited laboratory must work in compliance with the international standard ISO/IEC 17025. This, in turn, means that such a laboratory must be certified according to ISO 9000.

6.3 How is accreditation obtained?
An accreditation means that an authorized organization has provided a statement that specified requirements have been fulfilled and demonstrated. The organization is usually a government authority. The authority makes this judgement following a review of the management system, including organization, documentation, procedure and methods, and the competence of the personnel.

There are general requirements specified in the standard ISO/IEC 17025 to which laboratory specific requirements are added. A calibration laboratory must state in detail which services are offered, e.g., torque calibration of transducers with a specified best measurement capability, torque range, and which methods are used.

As a first step on the route to accreditation the management system must be both documented and implemented in practice. After application for accreditation a review is made by the authority. The management system is examined, both in documents and in practice, embracing practical work, documentation and administrative routines. Once the requirements are fulfilled, the authority can grant the laboratory accreditation.
6.4 What is the difference between accreditation, certification and declaration?

As described above, accreditation is the procedure by which an authority gives formal recognition that a laboratory is competent to carry out calibration tasks.

Certification is the procedure by which a third party gives written assurance that the calibration services of the laboratory conform to the specified requirements, e.g., ISO/IEC 17025. The term third party refers to an independent person or organization with no connection to the laboratory that provides the services, and with no user interest in the services.

Declaration is the statement issued by the laboratory providing the calibration services stating that they conform to the specified requirements. It is then up to the customer to decide if these services are of acceptable quality.

7. Factory calibration

Many accredited laboratories also offer so-called factory calibration. This is a simplified alternative to an accredited calibration. Factory calibrations do not necessarily adhere to any standard or internationally agreed specifications. The test equipment can, but need not be traceable back to the national standard. The measurement uncertainty is usually not stated. There is no formal stipulation regarding the contents of the certificate.
8. Accredited calibration services from Atlas Copco

By offering traceable, accredited calibration and accreditation services for transducerized tools, torque and angle encoders, as well as torque wrenches, Atlas Copco has earned a unique position among tool manufacturers.

Thereby the requirements of customers certified according to ISO 9001 or ISO TS 16949 are fulfilled. In some markets, simplified factory calibration of measuring equipment and certification of tools are also available. In addition, Atlas Copco laboratories perform calibration and reference measurements on-site, as well as surveys of tool and process capability at your premises.

8.1 Accredited calibration laboratories in Europe

The calibration laboratory in Essen, Germany, has been in existence since 1997 and became accredited by the German Calibration Service (DKD) 2004. The calibration laboratory in Milan, Italy, was established in 1987. It obtained accreditation from the Italian Calibration Service (SIT, Servizio Italiano Taratura) in 1992 and has also been ISO/IEC 17025-certified since November 2001.

Accredited calibrations for torque are carried out according to the European Standard EA-10/14 and German DIN 51309. From 2007 the Essen lab is offering accredited angle calibration of in-line transducers and power tools.

Homologation is a tool type test also offered by our calibration lab in Essen. For this test, up to three tools of the same type are normally tested following an extensive procedure. These tests take considerably longer than the tool capability test. Here, the $C_m$ and $C_{mk}$ values of the tool type are determined. (For more information please contact your nearest calibration center.)
8.2 Accredited calibration laboratory in North America

The United States Calibration Laboratory is located in Detroit and has been accredited to ISO/IEC 17025 since 2001 by L-A-B, the Laboratory Accreditation Bureau. The facility has been accredited to ISO 9001 since 1997.

The laboratory performs accredited calibrations of torque transducers, wrenches and power tools. Factory calibrations and proficiency (performance) tests of power tools under ISO 9001 of measuring torque devices are also performed.

North American automakers require their QS-9000/TS-16949 registered suppliers to utilize accredited independent testing or calibration laboratories to assess compliance with ISO/IEC 17025. The requirements are applicable not only to direct suppliers to the automotive manufacturers, but extend to the subcontracted testing and calibration laboratories used by their suppliers.

8.3 Accredited calibration laboratory in South America

Atlas Copco Brazil Calibration Laboratory is located in São Paulo and started its activities in 1996. It was accredited by the Brazilian National Institute of Metrology, INMETRO, according to ISO/IEC 17025 in December 2004. Today the lab has the greatest range of services in Latin America.

The lab offers accredited calibration for both in-house calibration of torque transducers, torque wrenches and electrical tools, and on-site calibration of electrical tools. In addition, panel indicators, angle of electrical tools and angle of torque transducers are calibrated with traceability to national standards. The Brazilian laboratory offers only accredited calibration and not factory calibration.

INMETRO is responsible for the evaluation of laboratories according to ISO/IEC 17025 requirements. Once a lab is approved by INMETRO it becomes part of the Brazilian network of Accredited Calibration Laboratories (RBC). As INMETRO is a member of ILAC, all laboratories accredited by INMETRO are recognized in all countries belonging to ILAC, International Laboratory Accreditation Cooperation.
9. Summary of important standards and procedures

The most important standards relevant to quality management and industrial production are summarized here:

**ISO 9000 “Quality management systems: Fundamentals and vocabulary”:** defines the basic principles and terms of quality management systems. The standard describes which requirements a company’s management must satisfy in order to comply with a certain standard during the implementation of quality management. It can serve as information for implementation within a company, and can also be used to document certain standards for third parties.

**ISO 9001 “Quality management systems: Requirements”:** defines the requirements for a quality management system in the event that an organization must document that its products satisfy customer and legal requirements, and that it strives to increase customer satisfaction. This standard describes the entire quality management system.

**QS 9000 “Quality Systems Requirements”:** is an American set of rules and regulations developed to harmonize the special requirements of the automotive industry on the US market. It also contains an adaptation of the ISO 9001 system to the demands of the automotive industry. QS 9000 is now replaced by ISO/TS 16949.

**ISO/TS 16949 “Quality management systems – Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organizations”:** is a technical specification for quality management systems. Specific requirements are described here for using ISO 9001 for series and spare parts production in the automotive industry.

**VDA 6.1-6.4 “Qualitätsmanagement in der Automobilindustrie”:** is the German set of rules and regulations for the automotive industry. It is directed to suppliers of the German automobile manufacturers and is binding for them.
ISO/IEC 17025 “General requirements for the competence of testing and calibration laboratories”: describes the general requirements for competence of testing and calibration laboratories.

EN ISO 10012 “Measurement management systems – Requirements for measurement processes and measuring equipment”: describes the requirements for quality management of measuring management systems. This standard contributes to effective management of measuring and test equipment and its suitability for the intended use.

BS 7882 “Method for calibration and classification of torque measuring devices”: a British standard which specifies the requirements for the calibration of torque transducers, including those used for the calibration of hand torque tools.

ISO 6789 “Assembly tools for screws and nuts – Hand torque tools – Requirements and test methods for design conformance testing, quality conformance testing and re-calibration procedure”: International standard for industrial wrenches, both indicating wrenches and click wrenches.

ISO 5393 “Rotary tools for threaded fasteners – Performance test method”: the standard gives the user a method for evaluating and specifying the performance of power assembly tools. It specifies how the capability of the tools is measured and documented.

VDI/VDE 2647 “Anweisungen zur dynamischen Prüfung von Werkzeugen in Anlehnung an ISO 5393”: the guideline, developed by the Association of German Engineers, is based on the ISO 5393 performance test method.

VDI/VDE 2648 “Anweisungen für die rückführbare Kalibrierung von Drehwinkelmesssystemen”: the guideline, developed by the Association of German Engineers, defines traceable calibration of direct and indirect measure angle measuring systems.
10. Further sources of information

Further information about testing and calibration can be found at the following links on the internet:

- [www.ilac.org](http://www.ilac.org) ILAC: International Laboratory Accreditation Cooperation. ILAC is an international cooperation of laboratory and inspection accreditation bodies.

- [www.european-accreditation.org](http://www.european-accreditation.org) EA: European Cooperation for Accreditation, is the European network of nationally recognized accreditation bodies and a member of ILAC.

- [www.nacla.net](http://www.nacla.net) NACLA: National Cooperation for Laboratory Accreditation, provides coordination and focus for laboratory accreditation programs in US, member of ILAC.

- [www.dkd.info](http://www.dkd.info) DKD: Deutscher Kalibrierdienst, is the German official accreditation body for accreditation and supervision of DKD laboratories, member of EA and ILAC.

- [www.sit-italia.it](http://www.sit-italia.it) SIT: Servizio di Taratura, is the accreditation body in Italy for the calibration laboratories, member of EA and ILAC.

- [www.l-a-b.com](http://www.l-a-b.com) L-A-B: Laboratory Accreditation Bureau, Michigan US, provides laboratory accreditation services to independent and captive testing and calibration laboratories across North America, member of NACLA.

- [www.inmetro.gov.br](http://www.inmetro.gov.br) INMETRO: Instituto Nacional de Metrologia, The National Institute of Metrology, Standardization and Industrial Quality, is the official accreditation body in Brazil. It is also a member of ILAC.
Appendix

On the following pages you will find the accreditation certificates for the laboratories in Europe, North America and South America, and sample calibration certificates.
Deutscher Kalibrierdienst (DKD)
Akkreditierungsstelle bei der
Physikalisch-Technischen Bundesanstalt (PTB)
vertreten im
Deutschen AkkreditierungsRat

Akkreditierung

Die Akkreditierungsstelle des Deutschen Kalibrierdienstes akkreditiert hiermit das Kalibrierlaboratorium für mechanische Messgrößen
bei
Atlas Copco Tools Central Europe GmbH
Kalibrierlaboratorium für die Messgröße Drehmoment
Langemarckstraße 35
45141 Essen

als Kalibrierlaboratorium nach DIN EN ISO/IEC 17025 für Kalibrierungen in den Bereichen:

Drehmoment

Bestandteil der Urkunde ist: Anlage 01 (1 Seite), 2004-07-23

DAR-Registriernummer: DKD-K-41401

Braunschweig, 2004-07-23

Dr.-Ing. Wolfgang Bosch
Leiter der Akkreditierungsstelle

Siehe Hinweise auf der Rückseite
SERVIZIO DI TARATURA IN ITALIA

ATTESTATO DI ACCREDITAMENTO

Centro di taratura n. 059

Il Responsabile della Segreteria Centrale del SIT attesta che il laboratorio metrologico della ditta

ATLAS COPCO BLM s.r.l.
Sede: Via Pepe, 11
20037 PADERNO DUGNANO (MI)


Torino, 08 Maggio 2006

Il Responsabile della Segreteria Centrale del SIT
(Dott. Ing. M. Mosca)

Mario Mosca
Certificado de Acreditação de Laboratório


Laboratory Accreditation Bureau
Certificate of Accreditation

Atlas Copco Tools & Assembly, Inc.
2998 Dutton Road
Auburn Hills, MI 48326

has been accredited for technical competence in the major fields and related disciplines on the approved scope of accreditation. They have met the requirements set forth in L-A-B’s policies and procedures, and all requirements of ISO/IEC 17025/1999 “General Requirements for the competence of Testing and Calibration Laboratories.”

Accreditation effective June 21, 2005 and valid through June 21, 2008

Peter B. Lake
Executive Director

R. Douglas Leonard, Jr., Chief Technical Officer
Laboratory Accreditation Bureau
**DEUTSCHER KALIBRIERDIENST**

Kalibrierdienst des Physikalisch-Technischen Bundesamtes

Kalibrationslabor für die Messung von Drehmomenten

Alle Abteilungen sind durch die PTB**-Zertifizierung der Physikalisch-Technischen Bundesanstalt (PTB) geeignet.

**Atlas Copco Tools Central Europe GmbH**

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**Bemerkungen:**

1. Die Ergebnisse wurden nach den Vorgaben der Norm DIN EN 60061-1 ermittelt.
2. Die Temperaturmessung erfolgte in einem geschlossenen Raum mit einer relativen Luftfeuchtigkeit von 40%.
3. Der Luftdruck wurde mit einem anerkannten Drucksensor gemessen.

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**Testing and Calibration in Assembly Technology**

1720_01_Calibration.indd 28 06-10-25 14:55:42
CERTIFICADO DE CALIBRAÇÃO

Número: SCXXXX06

Cliente:

Solicitante: O mesmo.

Data da Calibração: 29-04-06
Data da Emissão: 26-06-06

EQUIPAMENTO:

Tipo: Torquemetro Digital 500 Nm.
Fabricante: Atlas Copco.
Modelo: MRTT 600-200 / Acta 3000.
Classe: C.
Nº Série: 54155 / AS82007.

Valor de uma Divisão: 0,01 Nm
Sentido: Horário

Ref. Cliente: 0604700576 (1) / 0607001013 (3)

PROCEDIMENTO UTILIZADO:
Calibração de Torquemetros IT-05.13 r.06.

Observações:
Temperatura média do Laboratório: 21 ± 2°C
A incerteza expandida da medição relatada é declarada como a incerteza padrão da medição multiplicada pelo fator de abrangência k, que para uma distribuição normal corresponde a uma probabilidade de abrangência de aproximadamente 95%, conforme a publicação EA-452.


Não é permitida a reprodução parcial deste Certificado.

Atlas Copco Tools
Av. Santa Catarina, 1392 - Vila Santa Catarina
CEP 04678-990 - São Paulo - SP
www.atlas copco.com.br

Fone: (11) 5064 9100
Fax: (11) 5064 5646

Executado pelo técnico: Ricardo Araujo de Freitas
Gerente Técnico do Laboratório.
This instrument has been processed and calibrated in accordance with the Atlas Copco Tools and Assembly Quality Assurance Manual and is traceable to the National Institute of Standards and Technology (NIST). The Atlas Copco Tools and Assembly quality system is registered to ISO 9001:2000, LAB-accredited to ISO/IEC 17025:1994 and compliant with ISO 10201-1. This report may not be reproduced, except in full, without the written approval of Atlas Copco Tools and Assembly. Unless stated otherwise, the expanded measurement uncertainty of the measurement process does not exceed 20% of the tolerance allowed for the individual characteristics measured. The measurement uncertainties for this calibration are based upon 95% (2 sigma) confidence limits, no sampling plan or other process was used for this calibration, the results reported herein apply only to the calibration of the item described above, and no limitations of use apply to the calibrated unit. Although the item calibrated meets the specifications and performance at the time of calibration, due to any number of factors, the recommended due dates of the item calibrated does not imply continuing conformance to specifications during the recommended interval.

Uncertainty budget CAL002.01 Expanded uncertainty 95% confidence level 1.70% CAL001.03

Atlas Copco Tools and Assembly - 2998 Dutton Road - Auburn Hills, MI 48326

CALIBRATION TORQUE: 926.4 Nm UPDATED: NO

ADDITIONAL INFORMATION

ANGLE CHECKED YES NO

TEST PERFORMED BY:

SIGNATURE

---

30 TESTING AND CALIBRATION IN ASSEMBLY TECHNOLOGY
ZERTIFIKAT
Elektroschrauber

Zertifikatsnummer: AFRH-6Q34ED-00

Kunde: International Automotive Components Group GmbH
D - 50769 Köln

Gegenstand der Prüfung
Hersteller: ATLAS COPCO TOOLS
Maschinentyp: RTP 94-10-304-CEDS
Steuerung: PE 3007.15/WW

Reihenfolge
Hersteller: BLM
Sensor: Steuerung 3
Prüfung: 3996-18 D
Baumform: D3313 BKO-1-27981 64-43

Die Kalibrierung des Werkzeuges (Prüfung) wurde mit einer dynamischen Methode durchgeführt. Der Prüfung wurde auf dem Prüfstand geliefert.

Das Verfahren zur Prüfung der Maschinenfunktion erfolgte dynamisch und in Anlehnung an die Richtlinien der VDI/VDE 2547.

Die Messungen ergaben, dass die Abweichung des Prüfung innerhalb einer Abweichung von ± 25, des Referenzwerks, liegt.


Für die Erhaltung einer angemessenen Echt zur Wiederholung der Kalibrierung in der Prüfanlage, ist eine ausreichende Dauer alle 12 Monate zu wiedervorliegen.

Bearbeiter: J.-P. Bockenstedt
Gegengebiet: Th. Fischer

C_{ak} = 3,329

TESTING AND CALIBRATION IN ASSEMBLY TECHNOLOGY 31
Testing and Calibration Services from Atlas Copco

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If you have any questions, please contact your accredited Atlas Copco calibration laboratory:

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