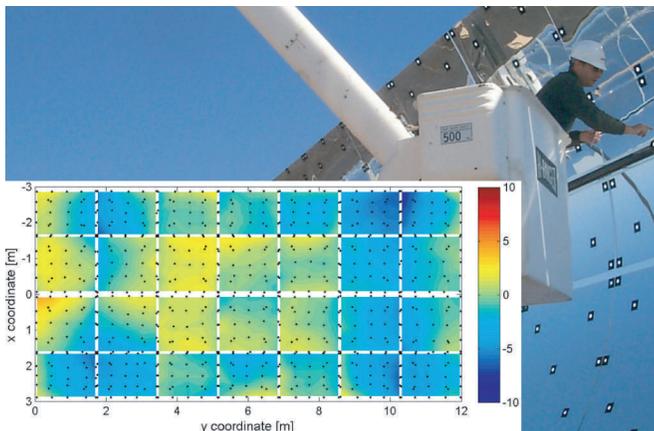


CONCENTRATOR MEASUREMENT AND SOLAR FIELD CONSULTING SERVICES

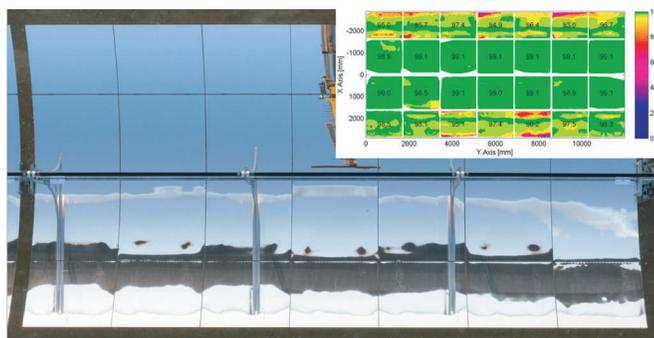
Quality Assurance and Optimization of Concentrators, Solar Field Assemblies and their Manufacturing Procedures

CSP Services exhibits ample experience in the assessment and optimization of the optical quality of a wide range of solar concentrators. We offer expert knowledge and measurement services to our clients worldwide. Our innovative and specific measurement techniques, software tools and expert know-how proved to be of great value for optimization of prototype collector designs and for quality assurance of large solar field assemblies.



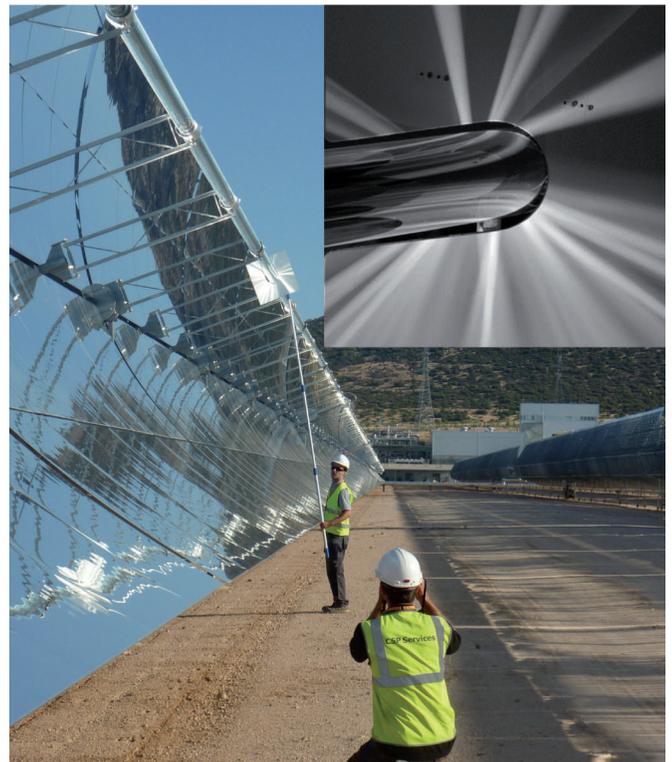
Photogrammetry of parabolic trough modules

Our measurements and related consulting services include all aspects of quality control in development, production and assembly, such as on-site measurements and supervisions, data analysis and interpretation, technical reviews, performance modeling, specification and qualification of components.



Deflectometry of parabolic trough modules

For our clients a precise concentrator shape is crucial for obtaining high optical efficiencies in their applications (parabolic troughs, heliostats, dishes and Fresnel systems). This is a challenging task for large-size structures, and of even more for light-weight structures and increased concentrator size. Module alignment, receiver position and collector torsion have also significant impacts on the final concentrator efficiency.



Intercept measurement (CTM)

Offered Measurement Services

3D Shape and Deformation Measurement

3D-point measurements of assembly jigs and concentrators with close range digital photogrammetry (PG). Results are point and angle deviations from design and deformation at different elevation angles.

Large-Scale 3D Measurement

3D-point measurements of distributed structures in the solar field with Tachymetry (TAC). Results are point-deviations, e.g. of foundations, pylon location or pylon orientation.

High-Resolution Concentrator Shape Measurement

Slope analysis with image recognition in photos based on Deflectometry (DEF) for parabolic troughs, dishes and heliostats. Results are high-resolution maps of slope deviation, focus deviation and intercept factor.

Local Intercept Measurement

The Camera Target Method (CTM) uses image recognition in photos of a flux target placed in the focal line. Results are local intercept factors along the collector and pictures illustrating the ray paths around the receiver tube.

Torsion Measurement

Measurements with high-resolution inclinometers to check collector balancing, friction of bearings and torsional stiffness of modules (TM).

Receiver Alignment Measurement

Relative distance measurements to the concentrator rim to determine the lateral receiver deviation from the focal line in parabolic troughs (RAM). Can be performed in different elevation angles to detect receiver movement.

Module Alignment Measurement

Measurements in parabolic trough collectors to determine the angle offset between neighboring modules (MAM).

Thermal Efficiency Measurement

Quasi-static or dynamic performance measurements with clamp-on or built-in temperature and flow sensors and high-precision DNI monitoring (TEM). Results are performance characteristics of test collectors, loops or commercial solar fields.

MEASURED CHARACTERISTIC	PROJECT PHASE			
	Jigs	Prototypes	Working Loop	Operating Field
Geometric accuracy	PG	PG	PG/TAC	PG/TAC
Concentrator shape	-	DEF	DEF	DEF
Deformation analysis	-	PG	PG	PG
Torsion due to unbalancing	-	TM/PG	TM	TM
Torsional stiffness	-	TM	TM	IM
Receiver alignment	-	PG/RAM	RAM	RAM
Module alignment	-	MAM	MAM	MAM
Local intercept	-	DEF	DEF/CTM	DEF/CTM
Module intercept	-	DEF	DEF	DEF
Thermal efficiency	-	-	TEM	TEM

Project Monitoring

We recommend measurements in every development step of a progressing project. On-site measurements take usually one to several days.

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