Compensators, Stability Check, and Automatic Target Recognition

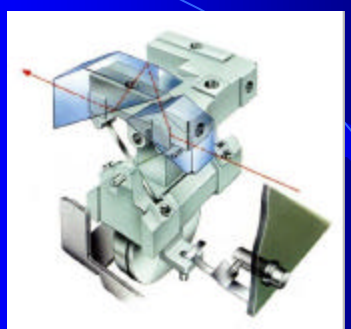
Compensators

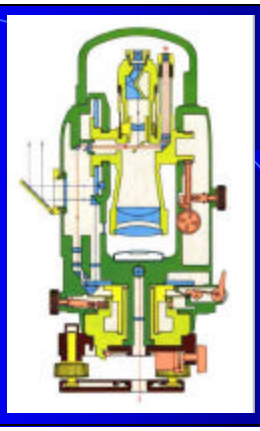
Aircraft Artificial Horizon

- Utilize Gyros to Determine the Horizon
- Work at Any Attitude (Tilt) of the Aircraft
- Accurate to Only a Few Degrees

Compensators

- Mechanical Device - Establishes Artificial Horizon in Surveying Instruments
- Gravity Seeking
- Utilizes a Pendulum or an Oil Surface
- Dampened - Magnetically, Pneumatically, or Hydraulically





Compensators

- Extremely Accurate - TCA1800 = 0.3”
- Small Operating Range - Only a Few Angular Minutes From the True Horizon
- For The Compensator to Work: Instrument Needs to be Leveled To Within That Range

Compensators

- Some Compensators Simply Correct The Line of Sight - Example: Optical Levels; T16
- Others Provide Data to The Instrument Central Processing Unit, So That The Resultant Values Can Be Corrected Example: TCA1800; NA2002

Damping Systems

- Compensator Should be Free to Seek Gravity
- Near Frictionless - Take Too Long to Settle
- Solution: Damping Systems
- Dampened - Magnetically, Pneumatically, or Hydraulically

Single Axis Compensators

- Compensator Monitors Tilt in Longitudinal Axis - Parallel to Telescope
- Corrects Zenith Angle for Standing Axis Tilt Error
- Theodolites Can be Leveled Using The Compensator - Without the Bubble
- Example: T16, T1610, T2000

Dual Axis Compensators

- Compensator Monitors Tilt in Longitudinal And Transverse Axis
- Parallel and Perpendicular to Telescope
- Corrects Zenith Angle for Standing Axis Tilt Error

Dual Axis Compensators - 2

- Also Correct Errors Associated With Horizontal Angles Due to Tilt of the Standing Axis
- Theodolites w/Dual Axis Compensators Can be Leveled Without Turning the Alidade

TCA 1800

- Compensator Operating Range - 3' 47"
- Always Wakes Up With the Compensator On
- Compensator Can be Turned Off - For Power On Session
- Do Not Turn Compensator Off, Except in Rare Instances

Stability Check

What is it?

- The Compensator Is Subject to Small Disturbances From Wind, Vibrations, etc.
- Normally the Compensator Settles Down Quickly
- In Situations That Need the Utmost Accuracy, You Must Verify That the Compensator Is Settled Before Each Measurement

TCA 1800

- The TCA 1800 Can Be Configured to Check the Stability of the Compensator
- This Configuration Setting is Retained after Power Off

Stability Check - ON

- If The Setting is ON, the Instrument Checks the Compensator for Movement Before Each Measurement.
- If Movement is Detected, an "Error 355" is Issued and the Measurement Aborted
- If the Compensator is Stable, the Measurement Proceeds.

Stability Check - OFF

- If The Setting is OFF, the Instrument Does Not Check the Compensator for Movement Before Each Measurement.
- Uses the Compensator Reading As-Is
- Small Tilt Errors Could Exist

Resultant Positional Accuracy

Positional Accuracy is a Function of Distance and EDM Measuring Mode

EDM Mode	Distance	Accuracy
Standard	100m 500m 1000m	2mm 2 to 3mm 10mm
Precise	200m 500m 1000m	1mm 2 to 3mm 10mm

When to use Stability Check

For Most ODOT Work, With the Exception of Certain High Precision Control Surveys:

Keep Stability Check Off

Automatic Target Recognition

Motors...

- Motorized Instruments have 2 Motors:
  - One to Rotate the Alidade Horizontally
  - A Second to Rotate the Telescope Vertically
- The Motors may be controlled by:
  - The User
  - The Operating System
  - On-Board Programs

Motors...

- Motorized Instruments Do Not have Tangent Locks
- The Tangent Drives are 2 Speed Electronic Switches
- It's OK to Rotate the Alidade or Telescope Manually
- Motor Resolution is 2 Seconds

But Motors with ATR...

- Enables Automatic Angle and Distance Measurement to the Target without the User Accurately Sighting the Prism
- Enables The Instrument to "Lock On" and "Follow" a Moving Target

Motors with ATR...

- Enables One Person Remote Controlled Surveying
- Makes "Real Time" Mapping Much More Efficient

How ATR Works - Page 1

- A Laser Beam is Transmitted Coaxially Through the Telescope
- The Beam is Reflected by the Prism and Returned to the Theodolite
- The Received Beam is Recognized by an On-Board Camera (CCD Grid)

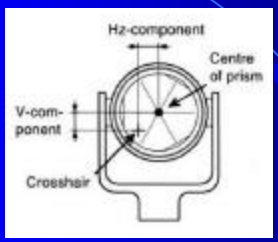
How ATR Works - Page 2

- The Position of the Received Light Spot (with respect to the center of the CCD Grid) is Computed.
- The Computed Horizontal and Vertical Offsets are used to Control the Motors to Turn the Instrument to Center the Crosshairs on the Prism

How ATR Works - Page 3

To Optimize Measuring Times:

- The Instrument Sights the Prism Center Coarser than the Specified Angular Accuracy
- The ATR System Measures the Offsets Between the Crosshair and Prism Center
- The Horizontal and Vertical Angles are Corrected and Displayed



How ATR Works - Page 4

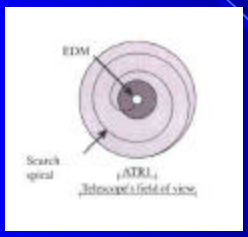
- The Horizontal and Vertical Angles are Measured to the Prism Center, Regardless of the Crosshair Pointing
- **Caution:** Determination of the ATR Collimation Error Must be Carried Out Periodically

How ATR Works - Page 5

The Search for the Target:

- The Sensitive Area of the ATR is Centered and about One-Third of the Field of View
- The Prism is Recognized Instantly within this Sensitive Area
- If the Prism is Outside the Sensitive Area, the Field of View is Scanned Spirally Searching for the Prism

ATR Search Pattern



ATR Stability Expectations

Mode	Stability
Standard	2mm
Precise	1mm
Fast	3mm
Tracking	3mm
Rapid Tracking	3mm

TCA 1800 Distance Modes

TCA1800 EDM Modes and Accuracies	
Standard	2mm + 2ppm
Precise	2mm + 1ppm
Fast	3mm + 2ppm
Tracking	5mm + 2ppm
Rapid Tracking	10mm + 2ppm

ATR Specifications - Page 1

Pointing Accuracy

Distance	Accuracy
100 m	2 mm
500 m	2 - 3 mm
1000 m	10 mm

ATR Specifications - Page 2

Range

	Standard Prism	360 Degree Prism
ATR Mode	1000 m	500 m
Lock Mode	700 m	350 m

ATR Specifications - Page 3

Rotation and Speed

	At Distance	Speed
Without Tracking	20 m 100 m	1 m/sec 5 m/sec
During Tracking	20 m 100 m	0.2 m/sec 1 m/sec

ATR Resolution Modes

- ATR Resolution is Defined as the Accuracy of the Center of Prism Determined by ATR
- Selecting Different Resolution Settings allows the User to Optimize Acquisition Speed for Various Accuracy Requirements
- The More “Inaccurate” that the ATR is Set, the Faster the Measurement

ATR Resolution Modes

Distance Mode	Crosshair Targeting	ATR Resolution
Standard	2”	1”
Precise	1.5”	0.8”
Fast	13”	7”
Tracking	13”	12”
Average	1.5”	0.8”