## TRAVERSE SPECIFICATIONS, SECOND ORDER

| CLASS | I | | II | |
|---|---|---|---|---|
| **Principal station spacing** | Seldom less than 4 km/ urban areas 0.3 km | | Seldom less than 2 km/ urban areas 0.2 km | |
| **Horizontal direction/angles** | | | | |
| Instrument | 0."2 | 1."0 | 0."2 | 1."0 |
| Number of observations | 8 or | 12[1] | 6 or | 8[2] |
| Rejection limit from mean | 5" | 5" | 5" | 5" |
| | | | | |
| **Length measurements** | | | | |
| (Electro-optical or infrared) | | | | |
| Minimum number of measurements | 1 | | 1 | |
| Minimum number of readings | 10 | | 10 | |
| Minimum number of concentric measurements | 1 | | 1 | |
| Minimum number of offset measurements | 1 | | 1 | |
| Standard error- | 1:300,000 | | 1:120,000 | |

Estimated by

$$\sigma_m = \sqrt{\frac{\Sigma v^2}{n(n-1)}}$$

| | | | | |
|---|---|---|---|---|
| **Reciprocal vertical angle observations** | | | | |
| Number and spread between observations | 3 D/R-10 | | 2 D/R-10 | |
| Number of stations between known elevations | 6-8 | | 8-10 | |
| Maximum time interval (hr) | 1 | | 1 | |
| | | | | |
| **Astro azimuths** | | | | |
| Number of courses between azimuth checks | 10-12 | | 15-20 | |
| Number of observations per night | 16 | | 12 | |
| Number of nights | 2 | | 1 | |
| Standard error | 0."45 | | 0."6 | |

**Azimuth closure at azimuth checkpoint:**

- Not to exceed 1."5/station or 3."0 √N
- Urban areas seldom to exceed 2."0/ station or 3"√N

2."0/station or 4."5 √N

Urban areas seldom to exceed 4."0/ station or 8"√N

## TRAVERSE SPECIFICATIONS, SECOND ORDER (CONTINUED)

| CLASS | I | II |
|---|---|---|
| **Principal station spacing** | Seldom less than 4 km/urban areas 0.3 km | Seldom less than 2 km/ urban areas 0.2 km |
| **Position closure[3]** | | |
| After azimuth adjustment | 0.08m √k or 1:50,000 | 0.2m √k or 1:20,000 |

**Where:**

N is the number of stations for carrying azimuth, and
K is the distance in kilometers.

[1] May be reduced to 8 in urban areas
[2] May be reduced to 4 in urban areas
[3] The expressions for closing errors in traverses are given in two forms.
The expression containing the square root is designed for longer lines where higher proportional accuracy is required.
Use the formula that gives the smallest permissible closure.

## TRAVERSE SPECIFICATIONS, THIRD ORDER

| CLASS | I | II |
|---|---|---|
| **Principal station spacing** | Seldom less than .05 km/urban areas 0.1 km | |
| **Horizontal directions/angles** | | |
| Instrument | 1."0 | 1."0 |
| Number of observations | 4 | 2 |
| Rejection limit from mean | 5."0 | 5."0 |
| | | |
| **Length measurements** | | |
| (Electro-optical or infrared) | | |
| Minimum number of measurements | 1 | 1 |
| Minimum number of readings | 10 | 10 |
| Minimum number of concentric measurements | 1 | 1 |
| Minimum number of offset measurements | 0 | 0 |
| Standard error -- | 1:60,000 | 1:30,000 |

Estimated by

$$\sigma_m = \sqrt{\frac{\Sigma v^2}{n(n-1)}}$$

## TRAVERSE SPECIFICATIONS, THIRD ORDER (CONT)

| CLASS | I | II |
|---|---|---|
| **Principal station spacing** | Seldom less than .05 km/urban areas 0.1 km | |

**Reciprocal vertical angle observations**

| | | |
|---|---|---|
| Number and spread between observations | 2 D/R-10" | 2 D/R-20" |
| Number of stations between known elevations | 10-15 | 15-20 |
| Maximum time interval (hr) | 1 | 1 |

**Astro azimuths**

| | | |
|---|---|---|
| Number of courses between azimuth checks | 20-25 | 30-40 |
| Number of observations per night | 8[1] | 4 |
| Number of nights | 1 | 1 |
| Standard error | 1".0 | 1".7 |

**Azimuth closure at azimuth checkpoint:**

| | | |
|---|---|---|
| | • Not to exceed 3".0/station or 10" $\sqrt{N}$ | 8".0/station or 30" $\sqrt{N}$ |

**Position closure[2]**

| | | |
|---|---|---|
| After azimuth adjustment | 0.4 m $\sqrt{K}$ or 1:10,000 | 0.8 m $\sqrt{K}$ or 1:5,000 |

**Where:**

N is the number of stations for carrying azimuth, and
K is the distance in kilometers.

[1]Can be reduced to 4 when a T-3 is used.
[2]The expressions for closing errors in traverses are given in two forms. The expression containing the square root is designed for lines where higher proportional accuracy is required. Use the formula that gives the smallest permissible closure.

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# TRAVERSE SPECIFICATIONS, SECOND AND THIRD ORDER

## Headquarters, Department of the Army
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