DTSK Series Connector System

1. INTRODUCTION

1.1. Purpose

This report summarizes the results performed on TE Connectivity (TE) DTSK Series Connector System to determine conformance to the requirements of product specification 108-151027

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the TE DTSK Series Connector System. Testing was performed at the TE Connectivity Industrial Commercial Transportation Laboratory in 2015-2016. The test file numbers for this testing are listed in Figure 1. This documentation is on file at, and available from, TE Connectivity Industrial Commercial Transportation Laboratory.

Test Group	Test Report
1-10	IPD150811-01 & WE-20150249ACL
11-13	IPD151208-01

Figure 1

1.3. Conclusion

The TE DTSK Series Connectors listed in Paragraph 1.4 conform to the electrical, mechanical, and environmental performance requirements given in product specification 108-151027.

1.4. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the part numbers given in Figure 2 were used for testing.

Part Number	Description	Test Group
DTSK04-1-08PA	Receptacle, “A” key	1-13
DTSK04-1-08PB	Receptacle, “B” key	1-13
DTSK04-1-08PC	Receptacle, “C” key	1-13
DTSK06-1-08SA	Plug, “A” key	1-13
DTSK06-1-08SB	Plug, “B” key	1-13
DTSK06-1-08SC	Plug, “C” key	1-13
DTSKF-1	Flange	1-13
1028-047-08005	Protective cover	11-13
SRK-PC-080-25-601	Ø8 Pin, wire size 25mm^2, 4 AWG	1-13
SRK-SC-080-25-601	Ø8 Socket, wire size 25mm^2, 4 AWG	1-13
SRK-PC-080-32-601	Ø8 Pin, wire size 2 AWG	1-13
SRK-SC-080-32-601	Ø8 Socket, wire size 2 AWG	1-13
SRK-PC-080-35-601	Ø8 Pin, wire size 35mm^2	1-13
SRK-SC-080-35-601	Ø8 Socket, wire size 35mm^2	1-13
WS-25-001	Wire seal, wire range 4 AWG, 25 mm^2	1-13
WS-32-001	Wire seal, wire range 2 AWG, 35 mm^2, 25 mm^2	1-13
WS-35-001	Wire seal, wire range 2 AWG, 35 mm^2	1-13

Figure 2

1.5. Environmental Conditions

Unless otherwise specified all tests and measurements were conducted within the following ambient limitations:

Temperature: 18° to 35°C [65° to 95°F]

Relative humidity: 5 to 95%

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Test Sequence (b)												
Examination of product	1	1	1	1	1	1	1	1	1	1	1	1	1
Contact Resistance (Voltage Drop)	2,6												
Vibration	4											2	
Durability	5												
Connector Retention			6								8		
Mating Force			2			2							
Unmating Force			3			3							
Mismating	7												
Maintenance Aging			4										
Terminal Retention in Connector			5								7		
Temperature Life	3					4							
Thermal Shock				6	2		6	2			4,6		
Water Immersion (IPX7 / IPX8)				2,7			2,7				2,5		2
Dust Protection (IP6X)				9			9						
High Pressure Spray (IPX9K)					3			3					
Water Immersion				4			4						4
Insulation Resistance											3		
Fluid Immersion		2											
Bend Test with Flange						5							
Terminal Crimp Strength										2			
Temperature Rise vs. Current									2				
Current-temperature Derating									3				
Visual Examination	8	3	7	3,5,8,10	4	6	3,5,8,10	4			9	3	3,5

a) Specimens were prepared in accordance with production drawings and were selected at random production runs.

1) Group 1-10 consisted of DTSK connectors, keys A, B and C, with DEUTSCH Ø8 contacts, with 25 and 35 mm², 2 and 4 AWG wire, with seals from each wire ranges and shrink tubing at the end of the connector. Group 6, 7 and 8 test with flange mount.

2) Group 11-13 consisted of DTSK connectors, keys A, B and C, with DEUTSCH Ø8 contacts, with 25 and 35 mm², 2 and 4 AWG wire, with seals from each wire, protective cover and the end of the connector. Group 13 only test with flange mount.

b) Numbers indicate sequence in which tests were performed.

Figure 3

2. TEST METHODS AND RESULTS

2.1. Examination of Product (Groups 1 through 13)

A. Test Method

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings, and overall quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, and torn seals or cracked plastic were considered adequate basis for rejection.

B. Requirements

The connectors shall be correctly constructed, marked, and shall show good quality and workmanship.

C. Results

All test samples were correctly constructed and marked. There were no defects or other evidence of poor workmanship. All samples met required specifications for examination of product prior to start of testing.

2.2. Contact Resistance (Voltage Drop) (Group 1)

A. Test Method

The test samples were energized by increasing the current until the test current listed in Figure 4 was achieved.

1. The samples were allowed to stabilize at the test current.
2. The voltage drop was measured and recorded.
3. The reversed voltage drop was measured and recorded.
4. The test sample voltage drop was calculated as follows:

$$\text{Specimen voltage drop} = \frac{\text{forward voltage drop} + \text{reverse voltage drop}}{2}$$

B. Requirements

Voltage drop are shown in Figure 4.

Contact Size	Wire Size	Test Current	Voltage Drop
	AWG [mm²]	Amp	mV max
Ø8mm	4 [25.0]	120	100
	2 [35.0]	150	100

Figure 4

C. Results

All samples met the requirements of Contact Resistance (Voltage Drop)

2.3. Vibration (Groups 1 and 12)

A. Test Method

The test samples were subjected to the vibration test, which was performed in the following manner:

1. The test samples were mounted to a fixture capable of transmitting the vibration conditions specified and designed so that there was no resonant vibration inherent in the fixture within the specified frequency range. Vibration input was monitored on the mounting fixture in the proximity of the support points of the test samples.
2. Sine vibration test levels were applied in each of the three mutually perpendicular directions using the following parameters:

<table>
<tr><td>Parameter</td><td>Requirement</td></tr>
<tr><td>Sine Sweep</td><td>10 to 2000 Hz</td></tr>
<tr><td>Initial Displacement</td><td>0.07 in [1.78 mm] DA</td></tr>
<tr><td>Maximum Acceleration</td><td>20 G’s</td></tr>
<tr><td>Test Duration</td><td>24 hours</td></tr>
<tr><td>Time Per Axis X, Y, Z</td><td>8 hours</td></tr>
<tr><td>Test Current

(first 3 hours each axis)</td><td>
<table>
<tr><td rowspan="2">Contact size</td><td>Wire Size</td><td>Test Current</td></tr>
<tr><td>AWG
[mm²]</td><td>Amp</td></tr>
<tr><td rowspan="2">Ø8mm</td><td>4
[25.0]</td><td>72</td></tr>
<tr><td>2
[35.0]</td><td>90</td></tr>
</table>
</td></tr>
<tr><td>Monitor for Discontinuity
(last hour each axis)</td><td>-</td></tr>
</table>

Figure 5

3. During the last hours of vibration in each axis discontinuity must be monitored. There shall be no discontinuity greater than 1.0 microsecond at 20mV and current of 100 milliamps.

B. Requirements

The test samples shall have no electrical discontinuity in excess of 1.0 microsecond, no disengagement of the mated connectors, no backing off of the coupling mechanism, and no evidence of cracking, breaking, or loosening of parts.

C. Results

There was no electrical discontinuity in excess of 1.0 microsecond and had no disengagement of the mated connectors, no backing off of the coupling mechanism, and no evidence of cracking, breaking, or loosening of parts. All groups met the requirements for vibration.

2.4. Durability (Group 1)

A. Test Method

The test samples were subjected to the durability test, which was performed in the following manner:

1. The connector were mated and unmated for a total of 50 complete cycles at room temperature.

B. Requirements

The test samples shall show no evidence of damage to the contacts, contact plating, connector housing or seals which may be detrimental to reliable connector performance.

C. Results

The test samples showed no evidence of damage to the contacts, contact plating, connector housing or seals which may be detrimental to reliable connector performance. All groups met the requirements for durability.

2.5. Connector Retention (Group 3 and 11)

A. Test Method

The test samples were subjected to the connector retention test, which was performed in the following manner:

1. A pulling force was applied to the wire bundle of the mated connector at 444 N. The load was applied for 30 seconds.

B. Requirements

There shall be no evidence of cracking, distortion or detrimental damage to the connector following the test.

C. Results

The test samples showed no evidence of cracking, distortion or detrimental damage to the connector following the test. All samples met the requirements for connector retention.

2.6. Mating / Unmating Forces (Group 3 and 6)

A. Test Method

The test samples were subjected to the mating/unmating forces test, which was performed in the following manner:

1. For connectors without mechanical assist, test the maximum required force to mate the plug and receptacle pair and engage the latching mechanism.
2. For connectors without mechanical assist, test the maximum force required to separate the plug and receptacle with the latch mechanism fully disengaged.

B. Requirements

Required force to mate the plug and receptacle pair and engage latching mechanism shall not exceed 100 N. Required force to separate the plug and receptacle pair and fully disengage latching mechanism shall not exceed 100 N.

C. Results

All connector plug and receptacle pairs were to mate and unmate without exceeding the maximum force of 100 N. All groups met requirements for mating / unmating forces.

2.7. Mismating (Group 1)

A. Test Method

The test samples were subjected to the mismating test, which was performed in the following manner:

1. The unintended polarization for connectors was tested with a 178 N minimum axial force to determine resistance to damage due to improper assembly during installation.

B. Requirements

Polarization and different keys shall resist a minimum of 178 N axial force without damage.

C. Results

The test samples showed no evidence of cracking, distortion, or detrimental damage to the connector following the test. All samples met the requirements for mismating.

2.8. Maintenance Aging (Group 3)

A. Test Method

The test samples were subjected to the maintenance aging test, which was performed in the following manner:

1. Each sample was subjected to 10 cycles of engagement and disengagement from its contact.

2. The contact cavity tested was visually inspected for damage.
3. All contact removal was done by hand. Insertion of contacts was done by hand with no insertion tool.

B. Requirements

The connectors shall meet visual requirements and show no physical damage.

C. Results

All test samples met visual requirements and showed no physical damage. All samples met required specifications for maintenance aging.

2.9. Terminal Retention in Connector (Group 3 and 11)

A. Test Method

The test samples were subjected to the terminal retention in connector test, which was performed in the following manner:

1. The contacts were subjected to a direct pull. The minimum value specified in Figure 6 was applied for 60 seconds.

Contact Size	Minimum Pull Out Force lbf [N]
Ø8mm	56 [250]

Figure 6

2. The pull was exerted on the conductor by means of a tension-testing machine or equivalent to prevent sudden or jerking force during test.

B. Requirements

The terminal shall maintain its original position in the connector throughout the test.

C. Results

The test samples maintained their original position in the connector throughout the test. All sampled met the requirements for terminal retention in connector.

2.10. Temperature Life (Group 1 and 6)

A. Test Method

The test samples were subjected to the temperature life test, which was performed in the following manner:

1. The wired, mated connectors were subjected to 1000 hours of heat in a circulating air oven at 125°C [257°F].

B. Requirements

There shall be no evidence of cracking, distortion, or other damage detrimental to the normal operation of the connectors.

C. Results

There was no evidence of cracking, distortion, or other damage detrimental to the normal operation of the connector. All groups met the requirements specified for temperature life.

2.11. Thermal Shock (Groups 4,5,7,8, and 11)

A. Test Method

The test samples were subjected to the thermal shock test, which was performed in the following manner:

1. The cabled-mated connector shall be subjected to 10 cycles of thermal shock.
2. One cycle shall consist of a soak time at –55 °C ambient, then a transition within 2 min to an ambient of 125 °C, with a soak time there and then a transition back to -55 °C ambient within 2 min.
3. The soak times shall be established as the time necessary to bring the internal connector temperature on test to within 5 °C of each of the ambient temperatures.

B. Requirements

There shall be no evidence of cracking, chipping or other damage detrimental to the normal operation of the connectors.

C. Results

There was no visible evidence of cracking, chipping, or other damage detrimental to the normal operation of any connector. All the groups met the requirements specified for thermal shock.

2.12. Water Immersion - IPX7 / IPX8 (Groups 4, 7, 11 and 13)

A. Test Method

The test samples were subjected to temporary water immersion test, which was performed in the following manner:

1. The wired test samples were immerged under 1 m water for 30 min (IPX7).
2. The samples were examined for water ingress, then subjected to thermal shock per paragraph 2.11.
3. The wired test samples were immerged under 1 m water for 4 hours (IPX8).
4. The samples were examined for water ingress

B. Requirements

There shall be no evidence of water ingress into the connector housing.

C. Results

There was no evidence of water ingress into the connector housing. All groups met the requirements for water immersion.

2.13. Dust Protection - IP6X (Group 4 and 7)

D. Test Method

The test samples were subjected to the dust test, which was performed in the following manner:

1. The mated and cabled specimens shall be mounted in its normal operating position.
2. The specimens shall be subjected to 20 cycles of air and dust movement for 6 second intervals. Pause 15 minutes.

E. Requirements

There shall be no evidence of dust ingress into the connector housing.

A. Results

There was no evidence of dust ingress into the connector housing. All groups met the requirements for dust test.

2.14. High Pressure Spray – IPX9K (Group 5 & 8)

B. Test Method

The test samples were subjected to the pressure spray test, which was performed in the following manner:

1. The mated and cabled specimens shall be mounted in its normal operating position.
2. Specimens shall be subjected to water fan with rotational speed 5±1^0/min, water flow 14-16 l/min, water pressure 800-1000 kP, water temperature 80±5^{0}C for 30 seconds per position. Spray position: 0^0, 30^0, 60^0, 90^0.

C. Requirements

There shall be no evidence of water ingress into the connector housing.

D. Results

There was no evidence of water ingress into the connector housing. All groups met the requirements for high pressure spray.

2.15. Water Immersion (Group 4, 7 and 13)

A. Test Method

The test samples were subjected to the water immersion test, which was performed in the following manner:

1. The wired mated connectors shall be placed in an oven at 125 °C ± 3 °C for 1 h then immediately be placed in water with a 5% salt in weight content and 0.1 g/L wetting agent, to a depth of 1 m for 4 h.
2. Water temperature is to be 23 °C ± 3 °C. The ends of the cable are to be sealed during this test.

B. Requirements

Pass Insulation Resistance per paragraph 2.16.

C. Results

All samples had insulation resistance measurements that were greater than 20 MΩ. All samples met required specifications for water immersion.

2.16. Insulation Resistance (Group 11)

A. Test Method

The test samples were subjected to the insulation resistance test, which was performed in the following manner:

1. Using a 1000 VDC insulation resistance test measurement device or equivalent, check insulation resistance between each contact to each adjacent contact or housing edge.

B. Requirements

The insulation resistance shall be greater than 20 MΩ.

C. Results

All samples had insulation resistance measurements that were greater than 20 MΩ. All samples met required specifications for insulation resistance.

2.17. Fluid Immersion (Group 2)

A. Test Method

The test samples were subjected to the fluid immersion test, which was performed in the following manner:

1. Each wired, mated connector was subjected to immersion in one fluid only. The connectors were subjected to the following fluids:

Fluid (Concentration)	Temperature
Motor Oil 30 weight (100%)	85^{0}C
Brake Fluid (disc type 1, 100%)	85^{0}C
Diesel fuel #2 (90/10%)	60^{0}C
Antifreeze/Water mixture (50/50)	85^{0}C
Roundup Original (7.5%, 48 to 592 oz)	23^{0}C
Gear Oil 90 weight (100%)	85^{0}C
Aqueous Urea (32.5%)	23^{0}C

Figure 7

2. The mated, wired connectors were subjected to five consecutive cycles of fluid immersion. Each cycle was performed as follows:
   a. The mated connector was submerged in its corresponding fluid at ambient conditions for five minutes.
   b. The mated connector was then removed and allowed to air dry 24 ± 2 hours.
3. After completion of the fifth cycle of fluid immersion, the connector was visually inspected.

B. Requirements

The connectors shall show no visible evidence of damage detrimental to their normal operation.

C. Results

No visible evidence of damage detrimental to the normal operation of the connectors. All samples met the requirements specified for fluid immersion.

2.18. Bend Test with Flange (Group 6)

A. Test Method

The receptacle samples were mounted to flanges, the flanges were mounted to a metal plate in a horizontal position. A vertical force was applied to a point at the very end of the receptacle connectors.

B. Requirements

All samples were pushed to distraction, visual separation of the flange from the metal plate.

C. Results

All test samples were able to withhold between 170-180 lb. force.

2.19. Terminal Crimp Strength (Group 10)

A. Test Method

The tensile strength of the tested samples was tested by an apparatus at a constant speed within the rage of 20 mm to 100 mm/min.

B. Requirements

All samples were pulled to destruction.

C. Results

All samples met the requirements for terminal crimp strength per Figure 8

Cable Size	Minimum Tensile lbf [N]
25 mm^2 , 4 AWG	489 [2175]
2 AWG	562 [2500]
35 mm^2	598 [2660]

Figure 8

2.20. Temperature rise vs. current (Group 9)

D. Test Method

Energize test samples with a test to produce 5^{0}C to 10^{0}C temperature rise (stabilized condition). Repeat at a minimum of 4 consecutively increasing current levels with each additional level generating an additional temperature rise (min) of 10 above previous recorded.

E. Requirements

The temperature shell not exceed 40^{0}C

F. Results

T-rise vs. Current curves were generated.

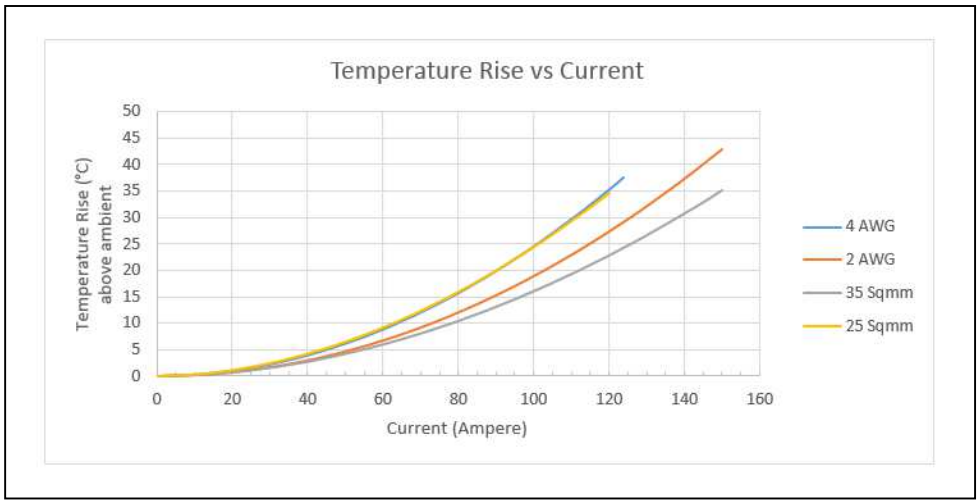

Figure 9

2.21. Derating (Group 9)

A. Test Method

1. The test samples were mounted in an enclosure which protects the immediate environment from external air movement.
2. Thermocouple probes were assembled to the rest samples to measure temperature increase as the contact as the current increases.
3. The current was increased in 1 amp step in held for 1 hour after thermal stability
4. The temperature and the current were recorded.

B. Requirements

Derating curves shall be documented for each terminal system.

C. Results

Derating curves were generated.

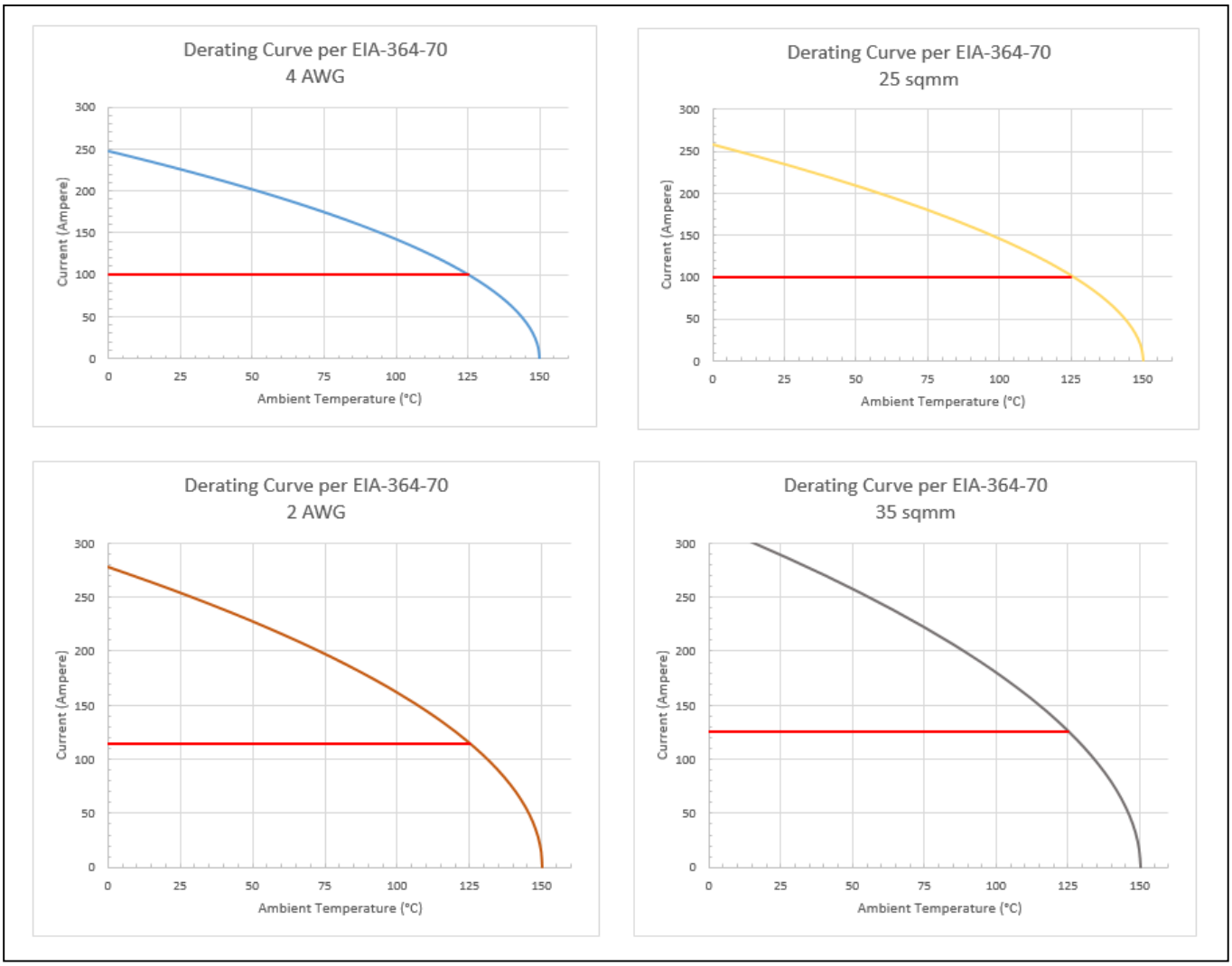

Figure 10

2.22. Visual Examination (Groups 1 through 13)

D. Test Method

1. The tested connectors were examined to determine the effects of previous testing.
2. Any evidence of torn seals, cracked plastic, loosening of parts, excessive wear, carbon tracking, or missing parts was recorded.

E. Requirements

The test connectors shall show no evidence of damage detrimental to normal operation. All markings shall be legible.

F. Results

The test samples showed no evidence of any damage detrimental to normal operation and all markings were legible. All test samples met the requirements for the visual examination.