



MODEL ASD3500A



ACCUSPEED ELECTRONICS UNIT

## 1 DESCRIPTION

The ACCUSPEED Laser Velocimeter is a non-contact, opto-electronic speed and length measurement device. It uses unique technology developed by KELK physicists to deliver performance beyond anything possible with conventional Laser Doppler Velocimeters (LDVs).

Rugged, millworthy construction allows ACCUSPEED to be used in hot and cold strip mills, tube mills, rod and bar mills, section mills, plate mills, and processing lines, as well as in other industrial applications outside metals rolling.

Two basic configurations of the ACCUSPEED are available - 'A' and 'B', each with a choice of 6 standoff distances, allowing users to select the best mounting arrangement for each application.

'A' model ACCUSPEEDs are designed for above the strip mounting (Figure 1), but can also be used to the side of slabs or underneath strips wherever space allows.

'B' model ACCUSPEEDs incorporate an optical periscope to allow use in confined-space applications above or below the strip, as well as inside the C-frames of thickness gages (Figure 2).

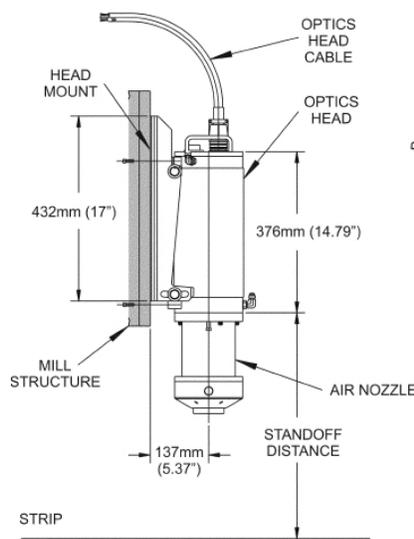


Figure 1

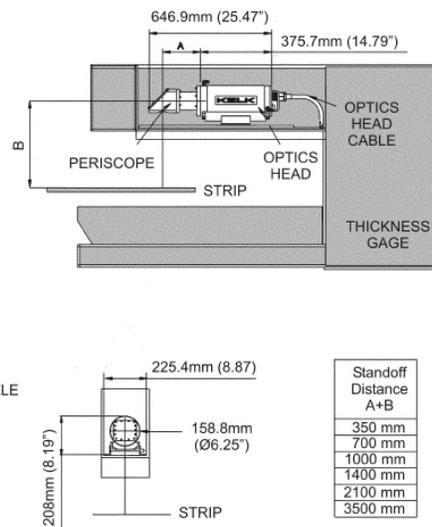


Figure 2

## **DESCRIPTION (cont'd)**

**ACCUSPEED is suitable for measurement and control applications throughout the metals rolling process, including:**

- speed measurement for Mass Flow Automatic Gage Control
- length measurement for Quality Verification
- differential speed measurement for Elongation Control
- transfer bar tracking for Crop Optimization
- flaw tracking for **Surface Inspection**
- speed tracking for Automatic Width Control
- length measurement for **Cut-to-Length Control**

## **2 COMPETITIVE ADVANTAGES**

### **2.1 Highest Speed Measuring Accuracy:**

ACCUSPEED is the most accurate laser velocimeter available. Conventional LDVs offer a “best case” accuracy of 0.05%, but much lower accuracy for slow moving targets such as transfer bars and for high sampling rates. ACCUSPEED is from 2x to 100x more accurate, delivering an accuracy of 0.025% which remains constant over the full target speed range.

### **2.2 Highest Length Measuring Accuracy:**

Conventional LDVs offer a constant length measuring accuracy of 0.05%. ACCUSPEED is more than 15x more accurate for short targets, and even better for longer targets; e.g 0.0011% for 1000 meter long strips (see table in Specifications), making it ideal for flaw or weld tracking.

### **2.3 Best “Zero Speed” Capability:**

When used with Low Speed (LS) electronics, standard ACCUSPEED models can measure low speeds down to 0.003 m/sec, almost 3x better than special models of conventional LDVs equipped with Bragg Cells.

### **2.4 Highest Sensitivity:**

Conventional LDVs need over 80% reflectance from the target for reliable measurement. ACCUSPEED needs just 5% reflectance, resulting in greater tolerance to environmental factors, higher dynamic range, and fewer, if any, dropouts.

### **2.5 Best Environmental Packaging:**

Conventional LDVs are designed for light industrial environments, and so require separate enclosures for rolling mill applications, together with removable windows for frequent cleaning. ACCUSPEED was designed with an integral water jacket for maximum efficiency, and a separate air nozzle that makes frequent cleaning unnecessary.

## **2.6 Longest Service Life:**

Conventional LDVs require laser replacement (or more) every year. ACCUSPEED laser life has proven to be from 4 to 10 years (and counting), there by minimizing both true costs and expensive downtime.

## **2.7 Highest Standoff Distance:**

ACCUSPEED is available with standoff distances up to 3500 mm - far greater than conventional LDVs. This provides maximum installation flexibility, while reducing the need for cooling and minimizing the risk of collision damage.

## **2.8 Fixed Periscopes:**

When used inside thickness gage C-frames and in other applications, conventional LDVs use separate moveable mirrors to bend the optical path. This practice both lowers accuracy and changes the basic calibration of the LDV. ACCUSPEED 'B' models use a special optical 'periscopes' that are fixed to, and calibrated with the optics head in order to maintain maximum accuracy and sensitivity during operation.

## **2.9 Largest Measuring Zone:**

ACCUSPEED models measure over a greater range than conventional LDVs - typically 200 mm. This means that ACCUSPEED can accomodate a 200 mm range of sizes of billets, rounds, tubes, beams, etc. from the same, fixed mounting position.

## **2.10 KELK Engineering Support:**

KELK Application Specialists study every potential user's requirements, select the appropriate equipment and produce a comprehensive installation drawing without charge. Should supplementary equipment be required to cope with environmental conditions, KELK engineers will design it free of charge and include it in the proposed KELK scope of supply.

# **3 SYSTEM CONFIGURATION**

## **Mill-Mounted Parts:**

### **3.1 OPTICS HEAD:**

The Optics Head is designed for use in a rolling mill environment. The optics chamber is filled with dry nitrogen and hermetically sealed in a robust, water-cooled stainless steel enclosure and can have a standoff distance of 350 mm, 700 mm, 1000 mm, 1400 mm, 2100 mm or 3500 mm. The optics head contains no user serviceable components.

### **3.2 AIR NOZZLE:**

The Air Nozzle keeps the optical window clean by blowing away pollutants, such as dust and steam, from the Optics Head. In 'A' models, the Air Nozzle is attached to the Optics Head.

### **3.3 PERISCOPE:**

In 'B' models, a Cold Duty Periscope Assembly is fixed to the Optics Head for installation above the strip. The Periscope Assembly allows the Optics Head to be mounted closer to the strip by bending the path of the laser beams emitted by, and returning to, the Optics Head.

### **3.4 HEAD MOUNT:**

The Head Mount is a rugged device used for mounting the Optics Head on the user's structure. It allows alignment of the head, while isolating it from shock and vibration.

### **3.5 2 – PIECE CABLE ASSEMBLY WITH JUNCTION BOX:**

The 2-Piece Cable Assembly links the Optics Head with the Electronics Unit. The Assembly includes 100 meters (330 feet) of Optics Head Cable, and a 10 meter (33 feet) Optics Head Extension Cable - Teflon with stainless steel braided Teflon hose. A Cable Junction Box is also provided allowing users to cut and terminate cables in the field to eliminate cable slack.

### **3.6 VERIFICATION DEVICES (Optional):**

Because of the extremely high accuracy of ACCUSPEED, it is not practical to build a portable calibration device that could match or prove factory calibration. However, two KELK Verification Devices are available for field use, one to confirm accuracy to 0.2%, the other to 0.1%. (Consult KELK for details.)

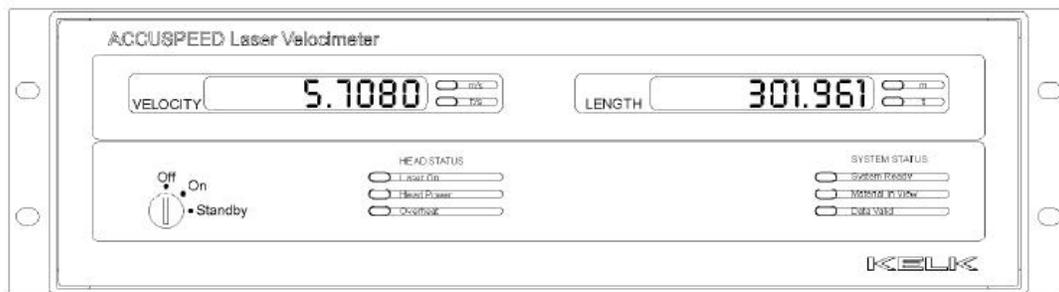
## **4 ELECTRONICS**

### **4.1 ACCUSPEED Electronics Unit:**

- 4.1.1 Processes the signals from the Optics Head
- 4.1.2 Monitors and reports on the quality of the Optics Head signals
- 4.1.3 Monitors and compensates for changes in the internal temperature of the Optics Head
- 4.1.4 Outputs the measured data
- 4.1.5 Provides user access for system setup, interrogation and diagnostics
- 4.1.6 Provides all necessary features for safe laser operation

The Electronics Unit mounts in a standard 19-inch rack or can stand on a bench top.

Two versions of the ACCUSPEED Electronics Unit (EU) are available. The 'Standard' EU allows measurement over the full speed range. The 'Low Speed' (LS) EU allows any Optics Head to be used to measure target speed in the range of 0.003 m/sec to 3 m/sec.



ACCUSPEED Electronics Unit Front Panel

## **4.2 User Access Program:**

Using pull-down menus and computer graphics, the User Access Program provides quick and convenient access to ACCUSPEED during installation, operation and service.

**It incorporates the following:**

- configuration module
- tool box
- operations monitor
- diagnostics module
- service log

Users can access these features either through the ACCUSPEED Communication Language and RS232 serial link supplied with ACCUSPEED, or through an IBM-compatible PC.

## **4.3 Standard Interfaces:**

**The ACCUSPEED Electronics Unit includes the following standard interfaces:**

### **4.3.1 ANALOG:**

The analog velocity output has a nominal range of -10 to +10 volts with a 16 bit resolution. The output scaling, span and zero levels are all field adjustable using the User Access Program.

### **4.3.2 QUADRATURE:**

Provides a two phase output which emulates a pulse tachometer. Comprises four differential RS485 signal outputs (+A, -A, +B, -B) which can drive a 100 ohm load at  $\pm 2$  volts. The frequency range is 10 Hertz to 303 kilo Hertz. The scaling factor is user programmable (default: 10 kHz per m/s).

### **4.3.3 SERIAL:**

A 9600 baud RS232 serial interface is provided for connection to a PC or host computer. The link is primarily used for setup and diagnostic purposes in conjunction with the User Access Program. The interface also supports the "ACCUSPEED Communication Language" (ACL) for development of custom protocols.

### **4.3.4 PARALLEL INTERFACE:**

A 16 bit parallel interface provides high speed access to velocity, length, and status information. Velocity and length are provided in 32 bit fixed point hex format. The output update rate is user programmable from 1 to 9999 milliseconds. Outputs are open collector type. TTL level and RS422 level are optionally available.

### **4.3.5 LOGIC I/O:**

Five relay outputs and two digital inputs are provided.

**Relay outputs are rated at 50 volts DC with a maximum current of 250 milliamperes (resistive load). The following outputs are provided:**

- System Ready
- Material in View / Length Reached
- Data Valid
- Laser On
- Head Overheat

**The digital inputs are optically isolated and requires 5 volts DC at 1.0 milliamperes. The functions provided are:**

- Start acquisition
- Material Direction

#### **4.4 Optional Interfaces:**

##### **4.4.1 Addressable Parallel Interface:**

The addressable parallel interface provides the same data as the standard parallel interface, but the transfers are controlled by the host computer, giving the user greater control over the data transfer process. Open collector and TTL level outputs are available.

##### **4.4.2 Profibus, Ethernet and Modbus/TCP interfaces are available.**

(Consult KELK for specifications and availability of **custom** interface options).

#### **4.5 Scope of Supply:**

##### **4.5.1 Model Designation:**

**ASDxxxxA or ASDxxxxB where:**

- ASD = ACCUSPEED
- xxxx = Standoff distance (mm)
- A = Optics Head with Air Nozzle
- B = Optics Head with Periscope

##### **4.5.2 Standard Scope of Supply:**

**Model ASDxxxxA:**

- 1 Optics Head
- 1 Air Nozzle
- 1 Head Mount
- 1 Accessory kit
- 1 2-Piece Cable Assembly and Junction Box
- 1 Electronics Unit (Standard or Low Speed)

**Model ASDxxxxB:**

- 1 Optics Head
- 1 Cold Duty Periscope Assembly
- 1 Accessory kit
- 1 2-Piece Cable Assembly and Junction Box
- 1 Electronics Unit

**4.5.3 Optional Equipment:**

- Heater/chiller for coolant temperature stabilization
- Laser beam dump
- Remote laser control panel
- Additional equipment as required to maintain a clear field of view.

(Consult KELK for details.)

**5 SPECIFICATIONS**

**5.1 Speed Range:**

<b>Standoff Distance</b>	<b>Target Speed (Low Speed EU)</b>	<b>Target Speed (Standard EU)</b>	<b>Depth of Measuring Zone</b>
350 mm	0.002 to 1.78 m/sec	0.006 to 25 m/sec	100 mm
700 mm	0.003 to 3.14 m/sec	0.01 to 44 m/sec	100 mm
1,000 mm	0.003 to 3.34 m/sec	0.01 to 47 m/sec	200 mm
1,400 mm	0.003 to 3.35 m/sec	0.01 to 47 m/sec	200 mm
2,100 mm	0.003 to 3.35 m/sec	0.01 to 47 m/sec	200 mm
3,500 mm	0.005 to 4.42 m/sec	0.015 to 62 m/sec	200 mm

**5.2 Length Range:** 0 to 15,000 meters (0 to 49,000 feet).

**5.3 Velocity Accuracy:** ±0.025% within 100 millimeter depth of field, ±0.05% within 100 - 200 millimeter depth of field.

Stated accuracy, as % of reading, can be obtained if all alignment parameters are met and Optics Head temperature is controlled to ±2.5°C within the 5°C to 40°C temperature range.

## 5.4 Length Accuracy\* ( $\pm 2$ Sigma):

Length of Target	Accuracy	Error
30 m	$\pm 0.0120$ %	$\pm 3.6$ mm
100 m	$\pm 0.0068$ %	$\pm 6.8$ mm
500 m	$\pm 0.0030$ %	$\pm 14.8$ mm
1000 m	$\pm 0.0022$ %	$\pm 21.2$ mm
2000 m	$\pm 0.0014$ %	$\pm 28.0$ mm

\* Under controlled conditions and Start/Stop length count by external signal

### **LASER DIODE:**

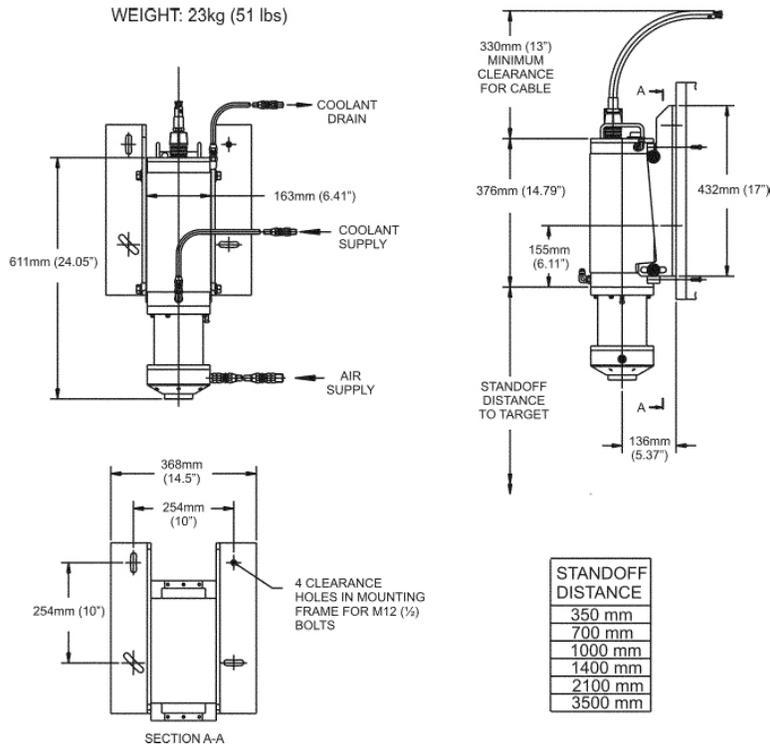
Near Infra Red, Invisible Radiation  
Normal Operating Condition 30 milliwatts  
Maximum power 110 milliwatts, 770-810 nanometers.

## 6 WHAT USERS MUST SUPPLY

- 6.1 Mounting Structure:** Consult KELK for recommended mounting arrangements. In some applications, protection from impact with product or debris may be required, as well as shielding of Optics Head, Periscope and/or cables from exposure to infrared radiation.
- 6.2 Power:** 120/230 volts AC, -10%+15%, 47-63 Hertz, 120 voltamperes.
- 6.3 Cooling Water<sup>2</sup>:** 4 liters per minute, 5° to 40°C (1 gallon per minute, 41° to 104°F).
- 6.4 Compressed air<sup>3</sup>:** 93 liters per minute at 310 kilo Pascals (3.3 standard cubic feet per minute at 45 pounds per square inch). Air to be filtered (40 $\mu$ m).
- 6.5 Relative Humidity:** Non-condensing environment
- 6.6 Operating temperature of Optics Head:**
- 6.6.1 WITHOUT COOLANT FLOW:** 0°C to 40°C (32°F to 104°F) ambient.
- <sup>2</sup> Only required if ambient temperature at the Optics Head location is less than 5°C or greater than 40°C, also recommended to maximize accuracy.
- <sup>3</sup> Instrument grade air, free of dirt and oil to prevent contamination of window.
- 6.6.2 WITH COOLANT FLOW:** 'A' Models: will operate above a 1,250°C (2,280°F) strip.  
'B' Models: Consult KELK.
- 6.7 Electronics Unit ambient Temperature:** 0°C to 40°C (32°F to 104°F).
- 6.8 For User Access Program:** IBM-Compatible PC with RS 232 Interface, capable of running Windows 98 or higher.

## 7 DIMENSIONS

### 7.1 ASDxxxxA Optics Head and Head Mount:



### 7.2 MODEL ASDxxxxB OPTICS HEAD AND COLD DUTY PERISCOPE:

