

Shunt calibration of strain gage measuring points for automatic long-term measurements

by Arno Westram

A calibration method for strain gages, which has been well proven over a number of years in marine engineering, consists of switching in a known parallel shunt in the bridge circuit using a relay. This produces a defined bridge unbalance. The technique is particularly effective for strain gages which are manually applied at poorly accessible points, such as for example ships' double bottoms which are often used as tanks. It is also possible to check the functional capability of the measuring point using this method.

Using a relay, the shunt is directly connected in parallel at the point of measurement to one of the active strain gages in the full Wheatstone bridge. A multicore cable is used, providing two cores for the 12 V DC relay supply. **Figure 1** shows the arrangement of a full strain gage bridge circuit, including two active and two temperature compensating strain gages. The relay and shunt are located on the solder tab strip and are assembled before application. **Figure 2** shows the circuit arrangement that was used.

It is important that the measuring point is made as flat as possible so that a waterproof covering layer can be

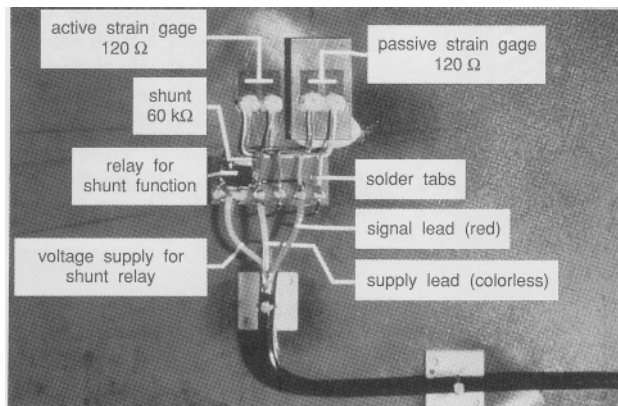


Fig. 1: Mounted strain gage with shunt and relay

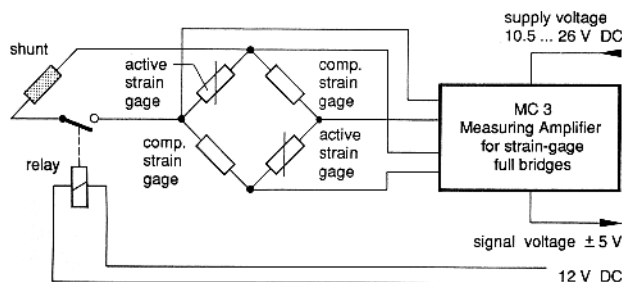


Fig. 2: Type of circuit used on board ship



Fig. 3: The ice-breaker "Mudjug" during testing of the compressed-water jets

applied and so that the risk of damage is minimized. When fitted on board ships, this type of measuring point may then be no longer accessible without a great deal of dismantling. Cable lengths of up to 100 m (328 ft) often occur with the cable in exposed positions. Repeated strain gage calibration involving the complete cabling is an important requirement for the reliability of automatically interrogated signals and for proving correct operation over extended periods. Drift, plastic deformations at the measurement location, poor insulation, cable damage and amplifier problems can be detected by switching in the shunt during equipment inspection in dock or during test measurements at sea.

The first successful use of this type of measuring point occurred in 1987 on board the Soviet ice-breaker "Mudjug". The ship, pictured in **Fig. 3**, had been fitted with a new type of bow which sprayed water onto the ice. During extensive testing in arctic conditions, 64 measuring points were interrogated simultaneously. Of these, 54 were strain gage measuring points mounted on longitudinal beams in the deck and bottom structures. These were checked each time using shunt calibration after ice-breaking had taken place.

At present a number of container ships have been fitted with measurement equipment by Germanischer Lloyd in order to acquire measurement data during normal ship operation on storm-swept routes. This data will then be used in design calculations and for serviceability assessment.

Dipl.-Ing. Arno Westram is Head of the Experimental Research Department at Germanischer Lloyd AG in Hamburg, West Germany.