= Gullfisk =

Class B and Class E , normally referred to as Gullfisk (Norwegian for " goldfish ") , were a class of 46 trams built by Strømmens Værksted and Skabo Jernbanevognfabrikk for Oslo Sporveier and Bærumsbanen of Oslo , Norway , in 1937 and 1939 . They were the first aluminium trams to operate on the Oslo Tramway and the first bogie trams to operate on street lines . They had contemporary modern electronic equipment , a streamlined shape , and comfortable accommodation . Till 1964 , they were also faster than any other Norwegian tramcar or suburban railcar .

Six prototype trams were delivered by Strømmen in 1937 , with four different motor solutions , from AEG , Siemens , Vickers and Norsk Elektrisk & Brown Boveri (NEBB) . None of these were particularly successful , and the 40 serial production trams used conventional motors from ELIN . These were delivered in 1939 , with 20 (class E) being used by Oslo Sporveier mainly on the Kjelsås Line , but also on other services . The remaining 20 trams (class B) were leased to Bærumsbanen , that used them on the Kolsås and Østensjø Lines , and later on the Ekeberg Line .

From 1967 , Oslo Sporveier transferred all its trams to Bærumsbanen , where they remained in use until 1985 . The class has been involved in several fatal incidents , including the Strømsveien tram fire in 1958 . Six trams (prototype no 163 , nos 166 , 170 , 196 and 199) remain at the Oslo Tramway Museum ; whilst Oslo Sporveier has kept two and converted them to maintenance vehicles (nos 185 and 198) , painted them yellow with zebra stripes . They also kept one themselves as a veteran tram (no 183) .

= = Background = =

During the 1930s , Oslo Sporveier operated a fleet of 150 trams and 130 trailers . The latest series , the HaWa Class , had been delivered during the early 1920s and were , by the late 1930s , becoming old fashioned , with low speed , uncomfortable interiors and a two @-@ axle wheel arrangement . Increased competition from cars and buses made the tram company start a process to find a new " generation " of trams and buses . In 1935 , an agreement was made with Støммmens Værksted to build a series of aluminium @-@ bogied trams and buses . Since the last order , the tracks had been relaid farther from one another , so the tramway could operate 2 @.@ 5 metres (8 @.@ 2 ft) wide and 15 metres (49 ft) long trams .

The use of an aluminium body was controversial , and international experts recommended that the tram company should not choose that solution . The goal was to decrease the weight so the trams could operate with less @-@ powerful motors , giving a lower cost . The first prototype was a full @-@ scale model of a tram , built at Homansbyen Depot in 1935 , using an undercarriage from disused horsecars .

= = Construction = =

Strømmens Værksted delivered six prototypes for Oslo Sporveier in 1937 , all with slightly different specifications . They were numbered 158 ? 163 . The four main types of prototypes were later designated B2 (158 ? 159 with motors from Vickers) , E4 (160 with motors from Siemens) , E3 (161 ? 162 with motors from AEG) and E2 (163 with motors from NEBB) . The trams were taken into use in February 1937 on the Kjelsås Line . They were capable of 65 km / h (40 mph) , compared to the maximum 35 km / h (22 mph) possible by the older trams . According to tests by J. G. Brill Co . , which was a specialist on high @-@ speed interurban railcars , streamline construction would afford a power reduction of 17 % at as low speed as 32 km / h (20 mph) .

Shortly after being taken into use , No. 158 lost braking power , killing one person when it landed on the pavement . The initial plan was to use the six trams to operate all services on the Kjelsås Line , with one vehicle in reserve , but this was not possible because of more out @-@ of @-@ service vehicles than estimated .

A further 40 units were ordered ? 20 from Strømmens Værksted and 20 license @-@ built by Skabo Jernbanevognfabrikk . The various experimental configurations fitted to the prototype trams

did not work too well ; and instead a conventional motor solution was chosen . The serial units were also not equipped with regenerative brakes . The series from Strømmen and Skabo received the same motors and bogies , but the electrical equipment was different . The Skabo series had electrical equipment from AEG and was optimized for street @-@ tram operation , while the Strømmen trams were optimized for the suburban tramways and equipped with electrical equipment from Vickers . The Strømmen series was delivered from February to June 1939 and leased to Oslo Sporveier 's subsidiary Bærumsbanen , that gave them the designation Class B. They were put into service on the Østensjø ? Kolsås Line , with both end stations far outside Oslo 's city limits that time . The trams partially ran through a relatively rural landscape , and more than any other Norwegian tramway this line may be called an interurban . The Oslo Sporveier trams were numbered 164 ? 183 , while the Bærumsbanen trams were numbered 184 ? 203 . The tram 's body was streamlined and had a tail at the end that made them look like a goldfish . They were therefore nicknamed " Gullfisk " , the Norwegian term for goldfish ; this later became the most common term for the class .

= = Operation = =

During World War II , the rationing of petroleum fuels gave a boost to ridership on the electric tramways . To handle the massive increase in ridership , the trams were equipped with two conductors . The single @-@ centre @-@ door solution that worked excellently before the war became a bottle @-@ neck as the trams became packed with riders . Lack of parts , particularly for the British Vickers motors , caused long waits for defective vehicles at the depots . From 1942 , the Kolsås Line was transferred to terminate at Nationaltheatret in the city centre , and the Class B was operated along the Lilleaker Line from the west . Trams 164 ? 166 were sent to Düsseldorf in Germany , but were never used because the city lacked balloon loops and the trams were too wide .

After the end of the war , Oslo Sporveier decided to transfer all the remaining trams to Bærumsbanen . Their high speed made them well suited on the light rail , but the centre door reduced their capacity . The order of the SM53 @-@ series from Høka gave Oslo Sporveier sufficient stock to operate the street lines , and from 1952 to 1957 , the company transferred the 19 trams to Bærumsbanen . Here , they were given the designation Class E. No. 163 was in too bad condition to be used on the line , and was retired . In October 1949 , no . 184 caught fire and was taken out of service . On 2 August 1958 , five people perished and 17 were injured in the Strømsveien tram fire , the worst disaster in the tramway 's history .

The Østensjø Line became part of the Oslo Metro in 1967 , and several of the Class E trams were transferred to other parts of the tramway . However , the Lilleaker Line was instead tied to the Ekeberg Line on the east side of the city , and the trams started operating on the Jar ? Ljabru service . After the last bus route had been converted to one @-@ man operation and the conductor replaced with a ticket @-@ selling motorman , Oslo Sporveier started the process of converting their tram fleet . No. 176 was converted as a trial , and after 1971 , all the remaining Gullfisks were converted . Because the trams had been delivered with a single front door , the cost of converting the trams was very little , and the single @-@ manning highly profitable .

In 1976 , no . 1976 was retired after it had lost braking power and crashed . After this , only selected trams were given overhauls , the last being no . 170 in 1980 . Following the delivery of the articulated SL79 , the Class B and E were gradually retired , with the last tram running into 1985 . Oslo Tramway Museum has kept six trams , while Oslo Sporveier kept two , converted them to maintenance vehicles and painted them yellow with zebra stripes .

= = Specifications = =

The Gullfisk were built as self @-@ contained aluminium riveted bodies . This gave a light body that was strong as steel , giving what at the time was regarded as a more elastic structure which would not break as easy . However , this resulted in the bodies sinking somewhat at the ends and between the bogies . It also caused more deformation during accidents , increasing the costs of repairs . The

bodies were 15 @.@ 40 meters (50 ft 6 in) long and 2 @.@ 50 meters (8 ft 2 in) wide . The centre beam between the two bogies was made of steel , and was intended to compensate for the soft aluminium structure ; these were prone to rust and needed repeated replacement . The bodies had a very streamlined shape and a distinct tail , that in addition to the aesthetic purpose was chosen because it strengthened the structure . During prototyping , the vehicle was tested in a wind tunnel .

The trams were unidirectional and had a single door at the front and a double door in the middle , both on the right side . Class E also had a single door at the rear . The trams were originally delivered with two apartments , with a wall and inside door in front of the centre door . This was removed after the trams became smoke @-@ free . They had a partial wooden interior , with linoleum floors . Various renovations changed the panelling , usually variations of brown and yellow . The trams originally had incandescent light bulbs , but these were replaced with fluorescent lamps after 1955 . From 1970 to 1974 , the trams were rebuilt to remove the conductor , and the driver was given space for a purse and ticket machine , as well as an announcement system . The E @-@ series eventually had the rear door taken out of use and blocked with an extra seat .

All but one of the trams had a SV36 @-@ bogie from Strømmens Værksted . The two bogies , each with two axles , were attached to the steel crossbeam . The aluminium body was attached to the crossbeam with leaf springs . The bogie frames were fastened to the axle box via a revolute joint and a spiral spring . Each bogie had two motors , each controlling one axle . In 1941 , no . 187 was equipped with a SV41 @-@ bogie from Strømmen ; it had a different spring system that allowed the tram to remain at the same height independent of the weight .

Class E was equipped with disc brakes , while the Class B was equipped with drum brakes . All the trams were equipped with rail brakes , and dynamic brakes . The serial production models were equipped with four 36 @.@ 6 @-@ kilowatt (49 @.@ 1 hp) ELIN BBFa20 motors . This gave a maximum speed of 65 km / h (40 mph) . They were built with two serial motors connected in parallel to the two other serial motors , so each motor used 300 V.

= = = Prototypes = = =

No. 158 and 159 were equipped with four 36 @.@ 5 @-@ kilowatt (48 @.@ 9 hp) Vickers 116E motors . This was a compound motor with regenerative brakes . The trams had sixteen regulating notches and were very complicated to operate . The technology had previously been used in Birmingham , but there the tram company had discontinued them quickly because of their complexity . This complicated set @-@ up was part of the reason for the fatal accident in Sannergata in 1937 . The regenerative brakes were removed in the late 1940s . The two trams ' motors were prone to technical failures , and spent much time in the workshop . They weighed 12 @.@ 87 tonnes (12 @.@ 67 long tons ; 14 @.@ 19 short tons) .

No. 160 was equipped with four 33 @.@ 5 @-@ kilowatt (44 @.@ 9 hp) Siemens DW331e motors . The motor controller and electrical equipment were run by a battery that was charged from the overhead wire . The motorman regulated the motor controller that again magnetized the motors . The tram was also equipped with regenerative brakes . Particularly the battery @-@ charging system had many defects , and the tram needed frequent repairs . Eventually the controller and regenerative brakes were removed . It weighed 13 @.@ 16 tonnes (12 @.@ 95 long tons ; 14 @.@ 51 short tons) .

No. 161 and 162 were equipped with four 33 @.@ 0 @-@ kilowatt (44 @.@ 3 hp) AEG USL2039 motors . They had a conventional design and regenerative brakes , although the latter was eventually removed . They had many technical difficulties , and held Bærumsbanen 's record in maintenance time . They weighed 13 @.@ 57 tonnes (13 @.@ 36 long tons ; 14 @.@ 96 short tons) .

No. 163 was equipped with two 50 @.@ 0 @-@ kilowatt (67 @.@ 1 hp) NEBB GLM1303 motors , one on each bogie that powered both axles . This caused problems because the monomotor required the wheels to be ground regularly to avoid uneven driving , but this was not discovered until 1941 . It weighed 13 @.@ 44 tonnes (13 @.@ 23 long tons ; 14 @.@ 82 short tons) .