Cable calculations for the below item in line with BS 7671 2008 17th Edition
CABLE SIZE

Typical Ze values for TN-S = 0.8, TN-C-S = 0.35 (OSG Section 7.1 page 55)

Known Information — Earthing System — **Ze =** 0.35 Ω
Length of circuit = 40 meters

See Table 10 of EN60204 (page 93) for 'Examples of maximum cable lengths from each protective load to its load'

Step 1. Find the Design Current:

Ib = W / V — W = 22000, V = 400 — Ib = 55 A

for 3 phase — PF = 1

Ib = W / (V x 1.732 x PF) = 22000 / 692.8 — Ib = 31.76 A

Step 2. Protective Device Rating:
The Protective Device rating (In) should be equal to or greater than (Ib), so

In = 32 amps

Step 3. Correction Factors: Section 5. (BGB page 309)
Apply any correction factors. If no factors need to apply then **(Iz) = (It)**

Ca = for ambient temperature. Table 4B1 & 4B2 (BGB page 325)	1
Cc = for circuit buried in the ground. Section 5.1.1 (iii) b (BGB page 308)	1
Cd = for depth of burial. Table 4B4 (BGB 326)	1
Cf = rating factor for semi-enclosed fuse to BS 3036 = 0.725 Section 433.1.101 (BGB page 81)	1
Cg = for grouping Table 4C1 (BGB page 327)	1
Ci = thermal insulation Table 52.2 (BGB page 129)	1
Cs = for thermal receptivity of soil. Table 4B3 (BGB page 326)	1

Grouping factor for cables in trunking. Section 2.3.3.1 (BGB page 306) — n = 2

F = 1 / √n — F is the group factor; n is the number of circuits in the group — F = 0.707

(Iz) = (In) / (Cg x Ca x Cs x Cd x Ci x Cf x Cc) — **(Iz) =** 32.000

Step 4. Cable Size:
Select cable from BS 7671 App 4. (Iz/t) > (In) > (Ib)

Eland SY (A5J) cable is table 4D2A. Installation Method B. (enclosed in trunking) (BGB page 334)
Eland SWA (A9S) cable is table 4E4A. Installation Method E. (free in air) (BGB page 348)

(Iz/t) = 77 amps

From table 4D4A — Reference Method C — Cable size = 16 mm

See table 52.3 (BGB page 130) for minimum cross-sectional area of condustors.

Step 5. Calculating circuit voltage drop: App 4. (BGB page 304)
Calculating circuit voltage drop:
For a lighting circuit the maximum permitted is 3% of the supply voltage.
(=6.9V for Uo of 230V, and 12V for U of 400V.)
For all other cuircuits the maximum permitted is 5% of the supply voltage.
(=11.5V for Uo of 230V, and 20V for U of 400V.)

For cables that have 3 figures: r (resistive) x (reactive) z (impedence). Use the z value for mV/A/m

Actual voltage drop = VD = $\frac{\text{length of circuit x design current (In) x mV/A/m}}{1000}$

for example, see Table 4D2B for **mV/A/m** of SY cable

VD= $\frac{40 \quad 32 \quad 2.4}{1000}$ = 3.072 V
= 0.768 %

Step 6. Shock Protection
Maximum permitted Zs from BS 7671 Table 41.3 (BGB page 56)
Circuit Breakers to BS EN 60898
OCPD (Overcurrent Protective Device) Type and Rating: Type C, Rating 32A

Maximum Zs = 0.72 Ω x 80% = 0.576 Ω

R1 = resistance of line conductor for a distribution or final circiut (Ω)
R2 = resistance of circuit protective conductor (cpc) for a distribution or final circiut (Ω)

To calculate actual Zs = Ze + (R1 + R2)

Zs = Ze+ (mΩ/m x length x change in temp) therefore **Zs = Ze+ (Ω/m / 1000 x length x change in temp)**
See OSG table I1 (sheet 182) or Ohms Page for Ω/m

Ω/m =	2.3
Max cable temp =	70
Temp change from 20deg =	50
Degree different = 1+(temp change x 0.004) =	1.2

Zs = 0.35 + (0.110) = 0.460 Ω

0.460 Ω should be lower than 0.576 Ω

Step 7. Thermal constraints.

To find actual fault current (If) = $\frac{Uo}{Zs}$ = $\frac{400 \text{ V}}{0.460 \Omega}$ = 868.8 amps

The use adiabatic equation to determine minimum CPC size. (BGB page 160)

S = is the normal cross-sectional area of the conductor in mm
I = Fault Current. (amperes) See (If) above — 868.8
t = Opening time of the protective device. (in seconds) (BGB pages 301-303) — 0.01
k = Factor taken from Table 54.3 (BGB page 161) — 115

S= $\frac{\sqrt{(I^2 \times t)}}{k}$ = ??mm $\sqrt{(I^2 \times t)}$ = 86.881

S= $\frac{\sqrt{(I^2 \times t)}}{k}$ = 0.76 mm

so nearest available size = 1.00 mm

If wiring the CPC in single then see Section 543.1.1 BGB (page 160)