PRODUCT SUMMARY

Introduction

Teleflex (Canada) Limited manufactures a wide range of Capilano hydraulic steering systems. These systems consist of components such as cylinders, valves, helms etc. which when connected together with tubing, fittings and hose form a 'closed loop' system. When the system is filled with hydraulic fluid and purged of air you have an operational hydraulic steering system.

In this section, we will discuss the main components of Capilano Systems with particular emphasis on the function of each component; model options; and our method fo designation. These components will then be organized into complete steering systems and different systems approaches will be reviewed (for example - single station vs dual station steering).

With this background, we move into a section called 'Steering Selection' guidelines which will familiarize you with a number of criteria to selecting the correct hydraulic steering system for any specific vessel.

MAJOR STEERING COMPONENTS

The following is a summary of the major components in any manual Teleflex Hydraulic Steering System. As the components are often called by different names, some of the synonyms are shown in brackets.

Cylinder (slave, ram, piston)
Helm (head, steering position, pump)
Uniflow valve

Other components which will be discussed in a later section include:

Tiller arms or linkages
Hydraulic lines (tubing, pipe, hose, fittings)
Accessories (wheels, indicators, etc.)

CYLINDERS

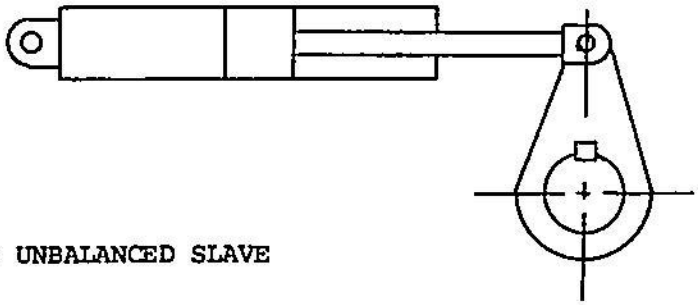
Teleflex (Canada) Limited manufactures several models and sizes of cylinders. It is important to recognize that the selection of a cylinder is always the starting point in determining what hydraulic steering system is best suited for a particular vessel. This is achieved by matching the cylinder output (torque) to the torque on a vessel's rudder or stern drive. Guidelines for this are discussed under 'Steering Selection'.

Cylinders can be balanced or unbalanced:

Unbalanced

This cylinder is designated as unbalanced since there will be more oil displaced from one side of the cylinder than the other. This is due to the presence of the cylinder rod in one side of the cylinder.

This cylinder is less expensive than a balanced cylinder but will result in slightly more turns hard-over on the steering wheel in one direction as compared to the other. This will result in more torque being delivered in one direction than the other. This is a useful feature where a propellor develops torque on a rudder in one direction more than the other, however as a general rule a single unbalanced cylinder should not be recommended.

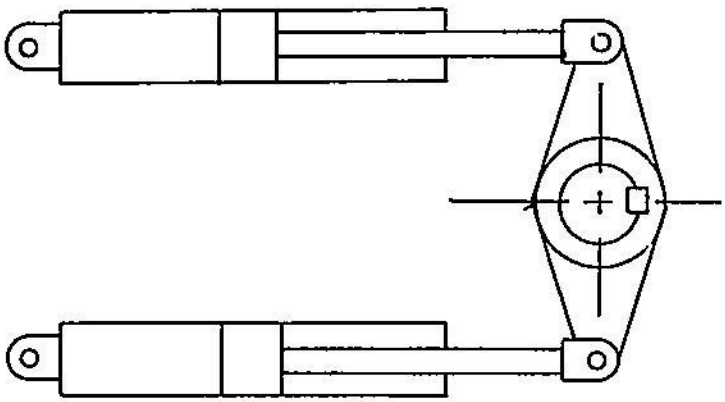


SINGLE UNBALANCED SLAVE

A single unbalanced cylinder:

- requires a Uniflow Valve in the system
- cannot be used with some automatic pilots

An increasingly popular use of Capilano unbalanced cylinders is with dual cylinder installation as shown below.



DUAL
SLAVE

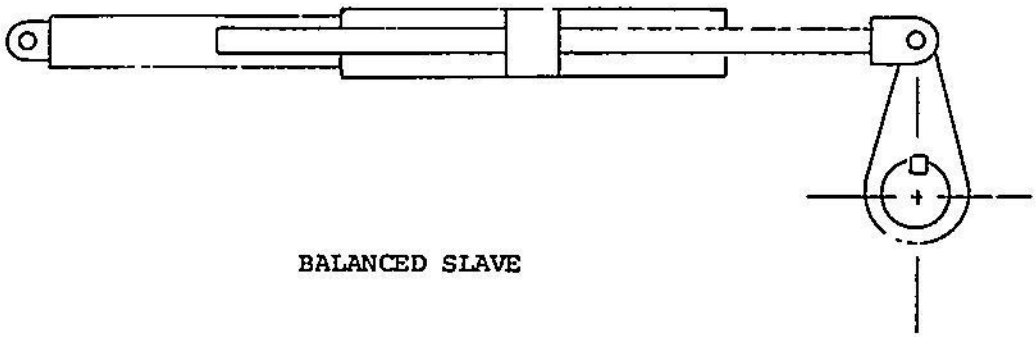
Two unbalanced cylinders coupled in this manner become in effect a balanced cylinder - thus the above restrictions on use of a single

unbalanced cylinder do not apply. The advantages of dual (parallel) cylinders are significant:

- minimal side thrust on the rudder post
- a sturdy, compact installation
- a back-up in case of failure on one cylinder
- smaller cylinders can be used

Capilano offers cross-over hydraulic hose kits which can be ordered to simplify the installation.

BALANCED



BALANCED SLAVE

A balanced cylinder contains a second or balancing cylinder rod to equalize the oil on each side of the cylinder. As a result it will produce an equal number of turns hard-over in either direction of steering.

CYLINDER IDENTIFICATION

Capilano cylinders are identified according to the inside diameter of the cylinder barrel and the length of the piston stroke. For example:

150-7 means 1 1/2" inside barrel diameter, 7" stroke
200-11 means 2" inside barrel diameter, 11" stroke

A further designation is made between unbalanced (standard) and balanced cylinders. For example:

BA175-7 means balanced cylinder with:
1 3/4" inside barrel diameter, 7" stroke
175-7 means unbalanced cylinder

CYLINDER OUTPUT

The cylinder output or torque is directly related to the volume of the cylinder. This is noted on the back page of Capilano product brochures, but summarized for all cylinders below:

CYLINDER	CYLINDER VOLUME (cu. in.)	MAXIMUM TORQUE (lb. in.)
BA125-7 BJ	7.2	2,311
BA150-7	10.2	6,548
BA175-7	13.7	8,794
BA200-7	18.9	12,133
2 - 150-7	23.0	14,766
2 - 175-7	31.0	19,900
2 - 200-7	41.0	26,322
2 - 175-11	45.0	28,890
2 - 200-11	61.0	39,162
2 - 225-11	81.0	52,000
2 - 250-11	98.0	62,916
2 - 250-15	134.0	86,028
2 - 300-15	194.0	124,548
2 - 350-15	262.0	168,204

STEERING HELMS

All Capilano helms contain precision made piston pumps with a built-in reservoir. There are currently eight models of helms with five different pumping rates. All helms with the suffix 'V' have a unique variable displacement feature. The latter is defined as the amount of oil pumped with each turn of the steering wheel.

For Example:

Syten - H-10 Helm	1.7 cu. in. per turn
Model 250V and 1250V	1.7 to 3.4 cu. in. per turn
Model 275V and 1275V	2.7 to 5.5 cu. in. per turn
Model 1350 and 1350s	8.1 cu. in. per turn
Model 1450	17.7 cu. in. per turn

The selection of helms is based on:
- number of turns required hard-over to hard-over (H.O. to H.O.) on the steering wheel

We previously indicated that the selection of the cylinder was the first step. Let us assume we selected a BA150-7 cylinder which according to our previous chart has a cylinder volume of 10.2 cu. in. What is the number of turns when matched with each of the above steering helms? Simply divide the cylinder volume by the helm output.

Example: $250V \text{ -- } \frac{10.2}{1.7 \text{ to } 3.4}$ = a maximum of 6 turns adjustable to a minimum of 3 turns

You can readily see where it would be impractical to match the Model 1350 or 1450 with a BA150-7 as the turns would be too low and hard steering would result.

The number of turns for each helm and cylinder(s) combination appears on each product brochure.

An option on helms is important as some vessels require very few turns H.O. to H.O. (sailboat), whereas with other vessels more turns are desirable.

You will note that Teleflex can cover a wide range of cylinder options. This number of cylinders offers a high degree of flexibility and opportunity to tailor a steering solution to vessels within our cylinder range.

SERIES 50

This series includes the model 250V and 275V helms.

A UNIFLOW VALVE MUST ALWAYS BE INCLUDED IN A STEERING SYSTEM USING SERIES 50 HELMS

The Uniflow includes a lock valve (to prevent rudder feedback) and a pressure relief for the steering system. Relief is provided against rudder shock and thermal expansion.

Series 50 helms (250V/275V should always be recommended when:
- 2 or more steering stations are required.
- A second steering station will be added in the future.

This Series 50 is gaining increased usage on single station installations because of:
- The fast purging capabilities of the Uniflow.
- Standardization of installation procedure for builders.

The alternative to using the Series 50 helms is the model 1250V helm, as described in a following section.

In general model 250V/275V helms along with the Uniflow Valve are installed on vessels under 50 feet in length. They are always installed with 7" stroke cylinders.

THE MODEL 250V/275V HELM

The 250V/275V provides an exciting and innovative improvement to current hydraulic steering systems on the market today.

The 'V' stands for variable. Using an adjustable knob, the helmsman can very the number of turns H.O. to H.O. on his steering wheel to suit the boating conditions or his preference. The range of adjustable turns is depended on the size of cylinder installed on his boat. For example, using a BA150-7 cylinder, turns can be adjusted from 3 to 6. The full extend of the model 250V capabilities are described in detail on the 250V/275V brochure.

A decorative bezel will be provided with each 250V/275V helm to cover the mounting bolts. Finished in a dull black, this bezel will identify the knob turning direction for more or less turns.

SUMMARY

Series 50 is the most advanced hydraulic steering system on the market today, because of the patented Uniflow Valve. (Note last page of this section.)

UNIFLOW VALVE

This is a patented exclusive Capilano product. It is manufactured in one model and comes complete with two - 18" hydraulic hoses to attach it to a slave cylinder. The capabilities of the Uniflow are summarized below but discussed in detail in the 'Facts Brochure', Page 3.

- provides fast simple purging of air
- eliminated airlock problems
- protects against rudder shock
- protects against thermal expansion
- eliminates the requirement for rising copper tubing from the cylinder to the helm

SERIES 1000

This series includes the model 1250V, 1275V, 1350, 1350s and 1450 helm. A Uniflow Valve is not installed with Series 1000 systems as the lock valve (to lock out rudder stresses) and the pressure relief valve are an integral part of each Series 1000 helm.

In General:

Model 1250V helms are installed with 7" stroke cylinders on vessels under 50 feet for single station installations. They are often considered where there are short connecting lines from the helm to the cylinder - e.g. sailboat or smaller pleasure boats.

With longer connecting lines and where a gradual use in the lines from the cylinder to the helm cannot be achieved - Series 50 systems should be installed.

Models 1350, 1350s are installed with 11" stroke cylinders on vessels 55 to about 80 feet in length for single or dual station steering.

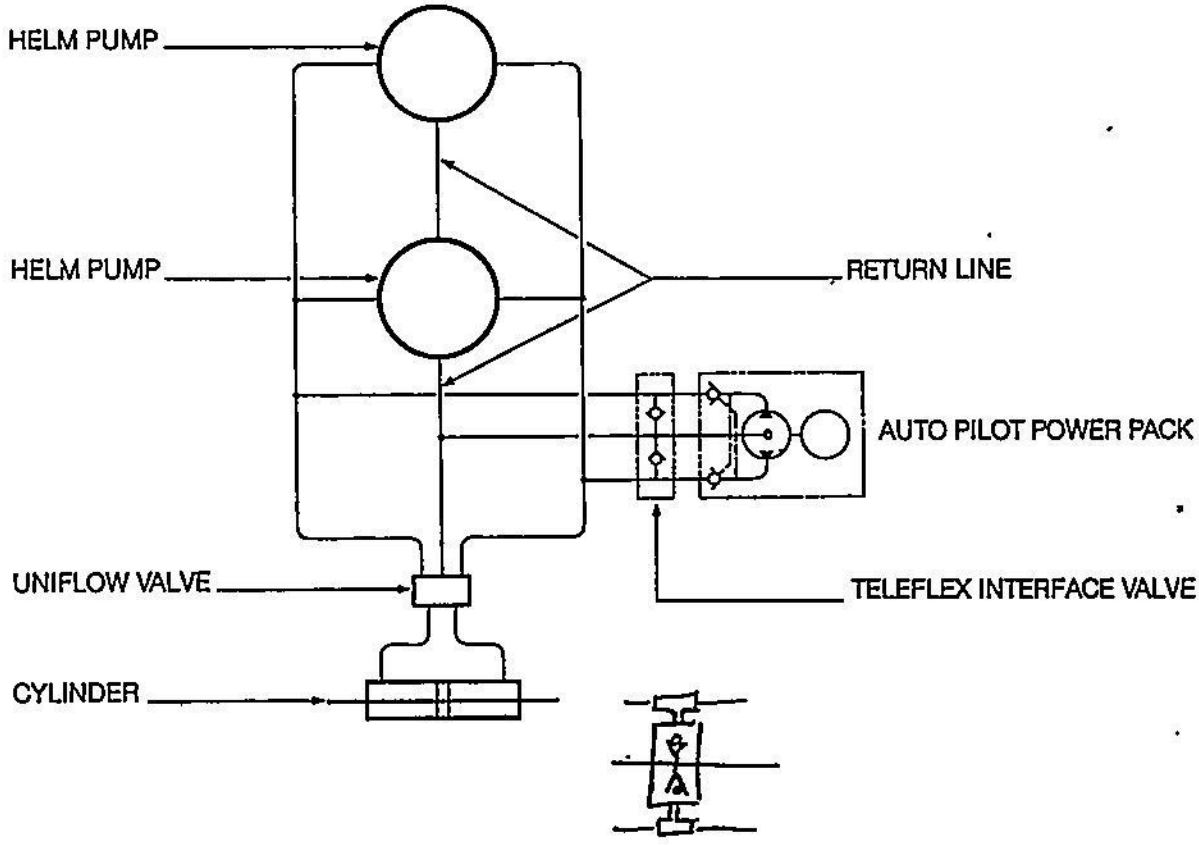
Model 1450 is installed with 15" stroke cylinders on vessels over 80 feet for single or dual station steering.

Please note that these are general guidelines since steering requirements are not necessarily established by the size of a vessel (note 'Steering Selection' section).

The model 1350s contains a two position lever. In one position it functions identically to a model 1350 helm and prevents any stresses on the rudder feeding back to the steering wheel. In the second position, rudder stresses are allowed to feedback to the steering wheel providing the helmsman with full 'feel' of the rudder. This is a feature sometimes requested by the ardent sailor.

INSTALLATION SCHEMATIC

FOR AUTO PILOT INTERFACE TO TELEFLEX 250V-275V SYSTEMS. INTERFACE BETWEEN HELM PUMPS OR HELM PUMP AND UNIFLOW VALVE ONLY.



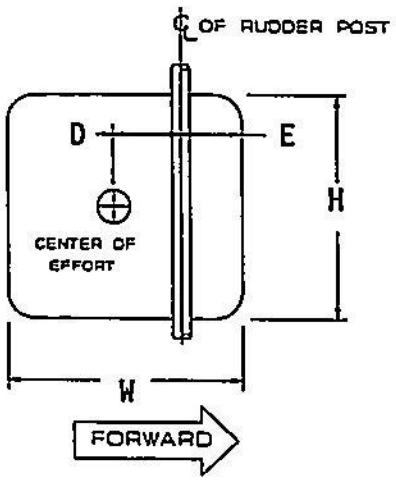
NOTE: A TELEFLEX AUTO PILOT INTERFACE VALVE, PART NO. HV4151 MUST BE USED AND CONNECTED AS SHOWN IN ABOVE SCHEMATIC IF AUTO PILOT POWER PACK IS TO BE INTERFACED TO THE HYDRAULIC STEERING SYSTEM BETWEEN HELM PUMP AND UNIFLOW VALVE OR BETWEEN HELM PUMPS.

Teleflex [Canada] Ltd.
1650 WEST SECOND AVE. VANCOUVER, B C. CANADA.

Attn: Tom Barns - Teleflex Fax # 270-7172

Teleflex (Canada) Ltd.

CALCULATING RUDDER TORQUE FOR DISPLACEMENT HULLS
DO NOT USE FOR PLANING HULLS



CUSTOMER MUST SUPPLY RUDDER DIMENSIONS AND MAXIMUM VESSEL SPEED AS REQUIRED IN LINES 1,2,3 AND 4 BEFORE GOING TO STEP 1

(1) AVERAGE HEIGHT — H = (1) 36 INCHES

(2) AVERAGE WIDTH — W = (2) 30 INCHES

(3) AVERAGE COUNTER BALANCE WIDTH (IF ZERO ENTER 0) — E = (3) 1 INCHES

(4) MAXIMUM SPEED (MPH X 1.15) = (4) 8 KNOTS

STEP 1. AREA = $\frac{H \times W}{144}$ = $\frac{(1) \times (2)}{144}$ = (5) 7 SQ/FT

STEP 2. FORCE = 3.37 X AREA X SPEED X SPEED

= 3.37 X (5) ____ X (4) ____ X (4) ____ = (6) 1881 LBS.

STEP 3. DISTANCE 'D' = (.37 X W) - E

= 0.37 X (2) ____ = ____ - (3) ____ = (7) 7 1/ IN.

STEP 4. TORQUE = FORCE X DISTANCE 'D'

= (6) ____ X (7) ____ = 14,000 IN/LBS TORQUE

NOTES:
- MULTIPLY TORQUE TIMES 2 FOR TWO RUDDERS
- MULTIPLY FINAL TORQUE TIMES 2 FOR VESSELS THAT PULL OR PUSH HEAVY LOADS
- SUBTRACT 25% OF TORQUE FOR SAILBOATS

STEP 5. USING TORQUE FIGURE, SELECT CYLINDER(S) AND HELM(S) FROM APPLICATION GUIDE

SELECT:
- CYLINDER MODEL ____ X ____ PART NO. ____
- HELM MODEL ____ X ____ PART NO. ____

BASED ON MODIFIED JORSSELS FORMULA

From Dan Fraser