

A.S.A. Test Report 03-72

AIRFOIL SECTIONS FOR FLYING MODELS

PROFILI ALARI PER MODELLI VOLANTI



ASSOCIAZIONE SPORTIVA AEROMODELLISTICA

via s. giovanni bosco 21

20081 ABBIATEGRASSO

milano - italy

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INTRODUCTION

1) WIND TUNNEL

The MEG wind tunnel is an open circuit design. A fan, driven by a 3 HP electric motor, blows air into a tranquillizing chamber. Air then enters a cylindrical, closed working section, having an internal diameter of 830 millimeters.

In order to straighten the flow, and to minimize its turbulence, a honey comb and a tight mesh screen are fitted ahead of the test section.

Velocity distribution in the test section has been positively tested for uniformity.

By turning upside down fully symmetrical test airfoil models, no appreciable angular deflection of the air flow has been detected.

The turbulence factor has not yet been determined.

2) MEASUREMENT SYSTEMS

Dynamic pressure in the test section is measured by means of a Prandtl type Pitot tube, connected with an alcohol manometer (Wilh. Lambrecht KG, Göttingen).

Temperature correction for alcohol density has been applied when transforming manometer readings into dynamic pressure.

Measurements by the Pitot tube have been checked with an anemometre.

Models are suspended upside down by means of wires in the test section; front lift, tail lift and drag are measured by means of three external balances of the two scales type.

The system accurately weighs forces as low as 0.05 grams.

Model angle of attack is measured with an accuracy of plus/minus 0,2 degrees.

3) MODELS

Models are made with high density polystyrene foam, covered with obeche veneer, sanded to smoothness but not doped nor varnished.

Standard model size is 600 by 120 millimeters; tips are fitted with 50 by 140 millimeters endplates.

Tolerances in airfoil accuracy have been found to be comparable with those usually obtained in model airplane building.

4) AERODYNAMIC COEFFICIENTS

Aerodynamic coefficients shown on the graphs are derived from the following relations:

$$\text{Lift Coefficient, } C_l = \frac{L}{\rho \cdot V^2 \cdot S}$$

$$\text{Drag Coefficient, } C_d = \frac{D}{\rho \cdot V^2 \cdot S}$$

$$\text{Pitching Moment Coefficient, } C_{mo} = \frac{M}{\rho \cdot V^2 \cdot S \cdot C}$$

Where:

- L = Lift (kilos)
- R = Drag (kilos)
- M = Moment (kilos . metre)
- V = Air velocity (metre/second)
- ρ = Air density (0.125 at sea level and 15 °C)
- S = Model surface (sq. metre)
- C = Model chord (metre)

Pitching moment coefficients are referred to the leading edge.

All coefficients are free of the weights of the models and of the suspension system, as well as of the aerodynamic forces acting on the wires.

Effects due to endplates, have not been corrected.

Due to the endplates, the actual aspect ratio, which all coefficients must be referred to, is 5,5, as it has been verified by means of tests run with and without endplates, as well as by means of calculations based on the ratio between endplate height and model span.

Drag coefficienta

Drag coefficients include also drag due to endplates ($C_d = 0.0013$).

No correction has been made for the wall effect of the wind tunnel.

Airfoil sections have been tested at angles of attack ranging from -2° to 8° , which are of practical interest to aeromodellers, and at Reynolds Numbers ranging from 40,000 to 60,000 (calculated according to model size and test velocity).

As a comparison between results obtained at the MEG wind tunnel, with those obtained in other test tunnels, the values C_l vs α° and C_d vs C_l of the NACA 6412 section (NACA Test Report No. 586) are plotted, after correction for the 5,5 aspect ratio, according to the simplified formulae:

$$\alpha_{\lambda=5.5} = \alpha_{\lambda=\infty} + \frac{2 C_{l\infty} \cdot 57.3}{5.5 \cdot \pi}$$

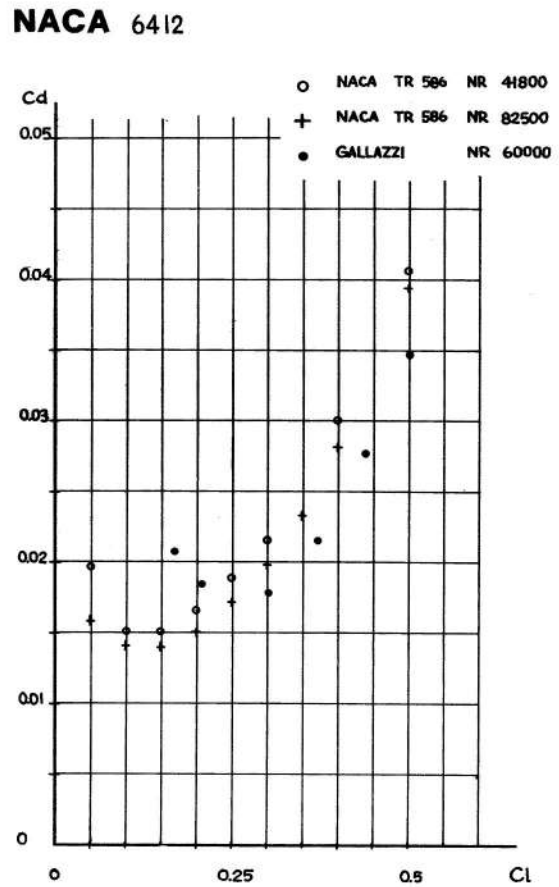
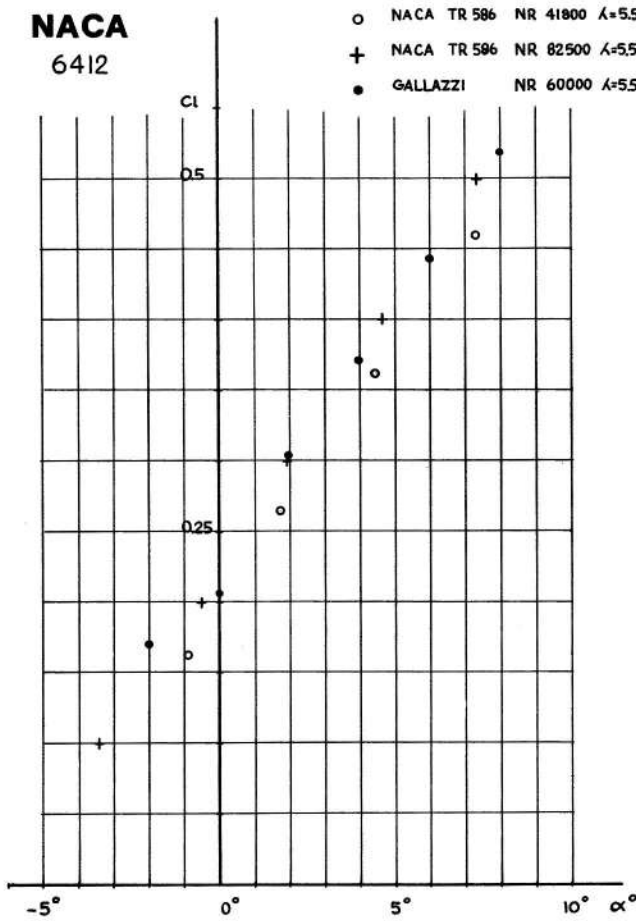
and

$$C_{d_{\lambda=5.5}} = C_{d_{\lambda=\infty}} + \frac{2 (C_{l\infty})^2}{5.5 \cdot \pi}$$

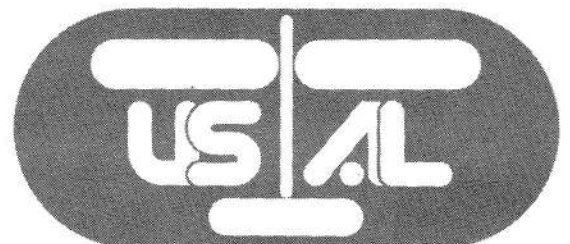
In comparing the results shown in this report with those obtained in other wind tunnels, one must consider the different surface roughness, the size tolerances of the sections, and the overall measurements accuracy of the MEG low speed wind tunnel. Consequently, while the results shown here are more than adequate for model airplane building, they cannot reasonably be compared with those obtained in wind tunnels of professional aerodynamic laboratories such as NACA (and others).

Dr. Ing. Angelo Bosco
(O.S.A.L. Model Aeroplane Club)
Novate Milanese

December 1972



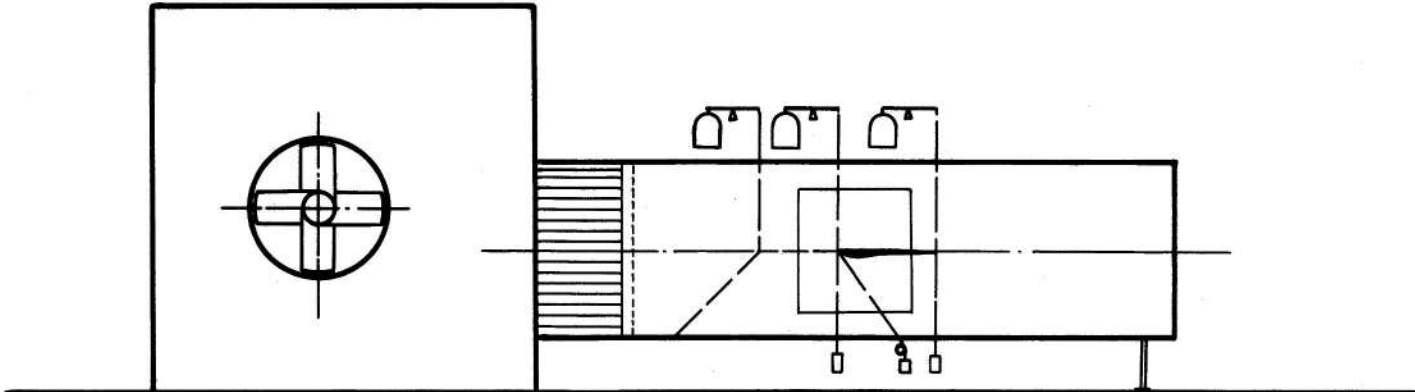
A.S.A is an independent aeromodelling club chartered by U.S.A.L.



INTRODUZIONE

1.) GALLERIA DEL VENTO

La galleria usata per i rilievi (vedere schema) è a circuito aperto. L'aria aspirata da una ventola azionata da un motore elettrico da 3 HP, passa in una camera di tranquillizzazione, e quindi nel condotto di prova vero e proprio all'imbocco del quale è posta una griglia in nido d'ape ed una rete a maglie fitte, allo scopo di distribuire uniformemente la velocità sulla sezione del condotto e di ridurre la turbolenza della vena. La camera di prova è chiusa ed ha un diametro di 830 mm. Sulla sezione di prova si è controllato che la distribuzione della velocità fosse uniforme. L'angolarità del flusso, determinata attraverso misure eseguite con modelli simmetrici, invertendo dorso e ventre, è risultata trascurabile. Fino a questo momento non è stato determinato il fattore di turbolenza della galleria.



2) SISTEMI DI MISURA

La pressione dinamica è rilevata sulla sezione di prova usando un tubo di Pitot tipo Prandtl collegato ad un micromanometro ad alcool "WILH. LAMBRECHT KG GOTTINGEN". Nel passare dalla colonna di alcool alla pressione dinamica si tiene conto della dipendenza della densità dell'alcool dalla temperatura. Le indicazioni del pitot installato in galleria sono state controllate con un anemometro. La sospensione del modello è a fili. Portanza anteriore, resistenza, portanza posteriore vengono misurate con tre bilance a piatti. La forza minima apprezzabile globalmente con questo sistema è di 0,05 gr. La tolleranza della misura dell'incidenza dei modelli è $\pm 0,2$ gradi.

3) MODELLI

I modelli sono costruiti in polistirolo ricoperto con obeche, scartavetrati e non verniciati, di dimensioni 600 x 120 mm con schermi 50 x 140 mm alle estremità. Le tolleranze dei profili, rispetto alle quote dei tabulati, sono dello stesso ordine di quelle ottenibili normalmente nella costruzione di aeromodelli.

4) COEFFICIENTI AERODINAMICI

I coefficienti aerodinamici riportati nei diagrammi sono definiti dalle seguenti espressioni:

$$\text{Coefficiente di portanza } C_l = \frac{P}{\rho \cdot v^2 \cdot S}$$

$$\text{" " resistenza } C_d = \frac{R}{\rho \cdot v^2 \cdot S}$$

$$\text{" " momento } C_m = \frac{M}{\rho \cdot v^2 \cdot S \cdot c}$$

(Il coefficiente di momento è riferito al bordo di attacco).

essendo:

P = portanza (kg)

R = resistenza (kg)

M = momento (kg.m)

V = velocità in m/sec.

ρ = densità aria (0,125 a livello del mare a 15 °C)

S = superficie modello (m²)

c = corda modello (m)

Essi sono dati al netto del peso del modello e del sistema di sospensione, e delle forze aerodinamiche agenti sui fili di sospensione. Non sono stati invece corretti degli effetti dovuti agli schermi di estremità. L'allungamento effettivo, per la presenza degli schermi, e al quale si devono riferire i coefficienti aerodinamici è circa 5,5 come è risultato da prove con e senza schermi e da calcoli eseguiti in base al rapporto tra altezza degli schermi ed apertura dei modelli.

Nei coefficienti di resistenza è compresa anche la resistenza degli schermi corrispondente ad un $C_d = 0,0013$.

Non sono state fatte correzioni per effetto delle pareti di galleria. I profili sono stati provati ad angoli di incidenza compresi tra -2° e $+8^\circ$ che sono le incidenza che interessano dal punto di vista aeromodellistico, e per numeri di Reynolds tra 40.000 e 60.000 (determinati in base alle dimensioni dei modelli ed alle velocità di prova).

Come confronto tra i risultati ottenuti in questa galleria e quelli di prove eseguite presso altre gallerie si riportano i C_l e C_d del profilo NACA 6412 ricavati dal Report NACA N. 586 corretti per allungamento 5,5 secondo le formule semplificate:

$$\alpha_{\lambda=5,5} = \alpha_{\lambda=\infty} + \frac{2 C_{l\infty} \cdot 57,3}{5,5}$$

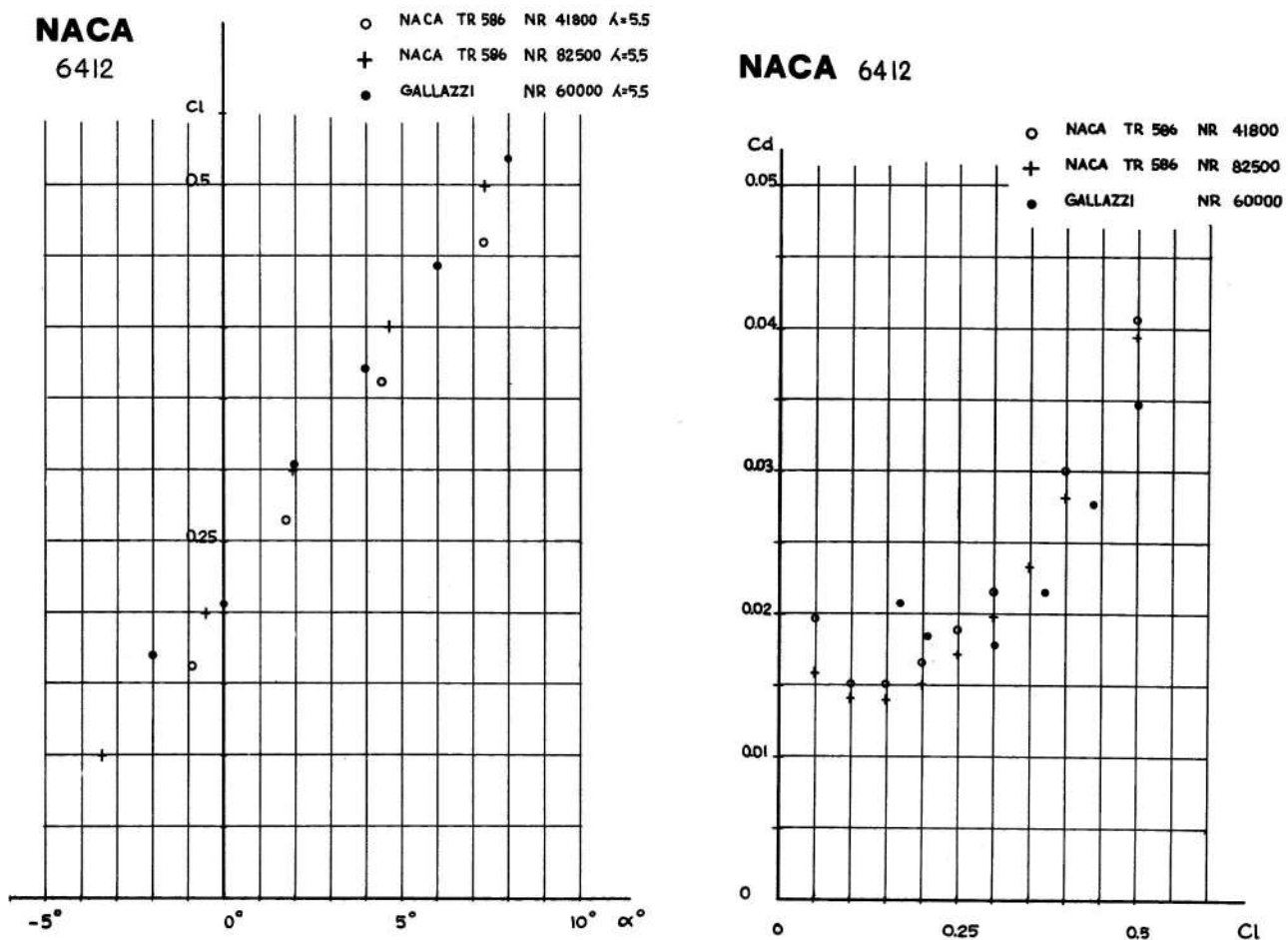
$$C_{d_{\lambda=5,5}} = C_{d_{\lambda=\infty}} + \frac{2 (C_{l\infty})^2}{5,5 \cdot \pi}$$

Nel giudicare il confronto, devono essere tenuti in considerazione le differenze di rugosità superficiale e di precisione delle quote dei profili ed infine l'accuratezza del sistema globale di misura ottenibile nella galleria MEG.

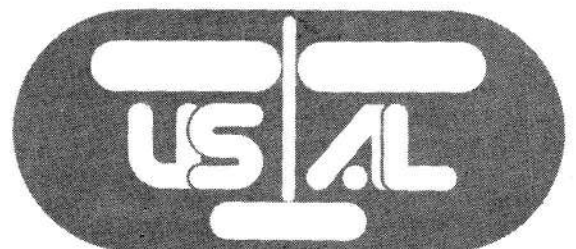
Pertanto, i risultati ottenuti mentre sono senz'altro validi per impieghi aeromodellistici, non sono ovviamente paragonabili a quelli ottenuti in gallerie del vento dei grandi centri sperimentali (NACA ed altri).

Ing. Angelo Bosco
(Gruppo Aeromodellistico O.S.A.L.)
Novate Milanese

Dicembre 1972



L'A.S.A. è un gruppo aeromodellistico
indipendente affiliato all'U.S.A.L.



FOREWORD

TO OUR AEROMODELLER COLLEAGUES

In testing a first series of airfoil sections, our fellow member Enrico Gallazzi (designer, builder and operator of the MEG low speed wind tunnel) was aiming at two targets:

- 1) To allow aeromodellers to make a practical comparison of airfoil sections tested at conditions similar to those encountered in real aeromodelling activity;
- 2) to obtain data (namely pitching moment coefficients), which allow one to draw the Crocco's graph, that is to establish with a graphical method the aerodynamic centre of the complete model, so that the position of the centre of gravity can be determined during the design.

This procedure minimizes adjustments which are required later on at the flying field.

Test results, presented in form of graphs and of tabulations, may be used for aeromodelling purposes within the validity limits of these tests as clearly stated in the Preface by dr. ing. Bosco, a professional aerodynamicist.

As long as test work at the MEG wind tunnel proceeds, we will keep our aeromodellers colleagues up to date, by issuing additional publications as well as by means of technical articles which will appear on the magazine MODELLI IN EUROPA, the official publication of Unione Sportiva Aeromodellisti Lombardi (U.S.A.L.), by which our club is proud to be chartered.

Test data presented in this publication may be used as described in textbooks on applied aerodynamics: Italian reading aeromodellers, who wish to avoid consulting such professional textbooks, may be interested in the ASA Technical Note 04-72 - APPUNTI SUL PROGETTO AERODINAMICO DI MODELLI VOLANTI (Notes on Aerodynamic Design of Flying Models), which is written in a very simple form for the layman.

Additional technical publications are being prepared: if you are interested, please let us know.

ASA wishes to express their wholehearted thanks to dr. ing. Angelo Bosco (O.S.A.L., Novate Milanese, aeromodelling Club) for his useful suggestions, as well as dr. arch. Ercole Macchi (Vergiate Aero Club) who has done the graphical presentation.

A.S.A.
Test Section

Abbiategrosso, December 1972

PREMESSA

Ai colleghi Aeromodellisti

Due sono gli scopi che il nostro socio Enrico Gallazzi (ideatore, realizzatore ed operatore della galleria del vento a bassa velocità MEG) si era prefisso nella sperimentazione di una prima serie di profili aerodinamici:

- 1) Consentire agli aeromodellisti un confronto pratico tra i diversi profili provati a condizioni che si avvicinano a quelle che si riscontrano in pratica
- 2) Ricavare dati (coefficiente di momento) che consentissero di realizzare il diagramma di Crocco, cioè la determinazione grafica del fuoco del modello completo, onde stabilire, già in fase di progetto, la posizione necessaria del baricentro.

Tale procedimento minimizza poi l'entità degli aggiustaggi da effettuare sul campo di volo.

I risultati, presentati in forma di grafici e di tabelle, sono utilizzabili per impiego aeromodellistico, nei limiti di validità delle prove effettuate, come meglio precisato nella introduzione dell'ing. Bosco.

Per chi non avesse familiarità con le notazioni in lingua inglese, riassumiamo qui di seguito le equivalenze:

<u>Inglese</u>	<u>Italiano</u>
C _l	C _p , Coefficiente di portanza
C _d	C _r , Coefficiente di resistenza
C _m	C _m , Coefficiente di momento (riferito al bordo di attacco)
C _l /C _d	E, Efficienza aerodinamica

Con il proseguire delle prove alla galleria del vento MEG, sarà nostra cura tenere informati i colleghi aeromodellisti, sia mediante l'emissione di altre documentazioni, sia mediante articoli illustrativi ed applicativi che compariranno sulla rivista MODELLI IN EUROPA, organo ufficiale dell'Unione Sportiva Aeromodellisti Lombardi, alla quale la nostra associazione si onora di appartenere.

I dati esposti in questa pubblicazione vanno utilizzati nel modo indicato nei testi convenzionali di aerodinamica applicata: chi volesse evitare di consultare trattati ponderosi, può utilizzare la pubblicazione ASA TN 04-72 - APPUNTI SUL PROGETTO AERODINAMICO DI MODELLI VOLANTI, redatta in forma piana ed accessibile a tutti.

Ulteriori pubblicazioni sono in corso di preparazione: chi gradisce essere tenuto al corrente, è pregato di comunicarcelo.

L'A.S.A. desidera infine ringraziare vivamente l'ing. Angelo Bosco (del Gruppo Aeromodellistico O.S.A.L. di Novate Milanese) per gli utili suggerimenti e la collaborazione, nonché l'Arch. Ercole Macchi (del Gruppo Aeromodellistico Ae.C. Vergiate) che ha curato la presentazione grafica.

A.S.A.
Sezione Sperimentale

Abbiategrosso, Dicembre 1972



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Sezione Sperimentale

MEG

low speed wind tunnel
 experimenter: enrico gallazzi

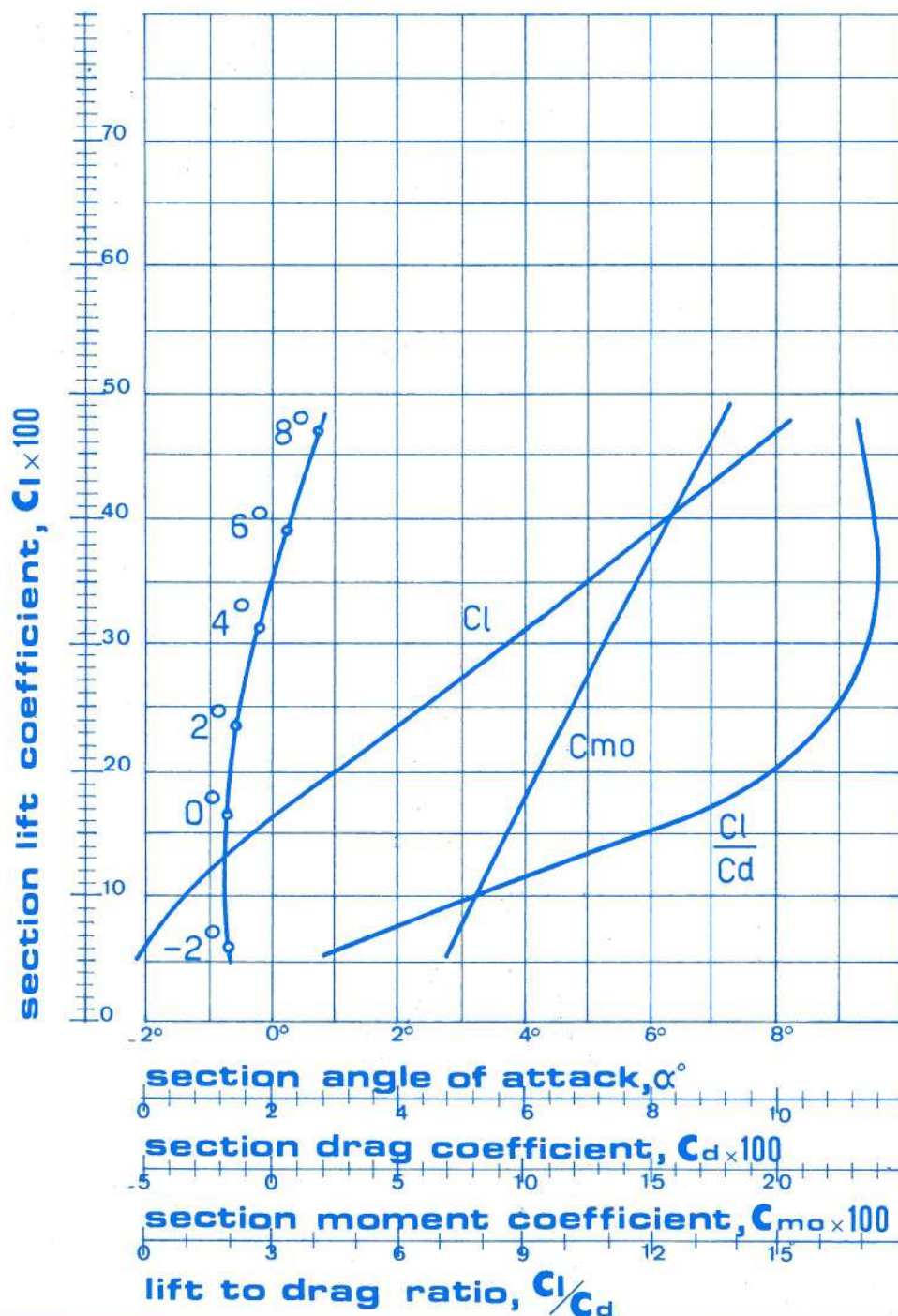
SECTION TESTED: BO 545 - 310



x	0	1	3	5	7	10	20	30	40	50	60	70	80	90	100
y_u	0	1.7	3	4	4.9	5.9	8.2	9.4	9.8	9.3	8.3	6.8	4.9	2.6	0
y_l	0	-1.2	-1.8	-1.9	-2	-1.9	-1.3	-0.6	0.1	0.6	1	1.1	1.1	0.7	0

TEST CONDITIONS

air temperature, deg.°C: 14°
 air velocity, m/sec: 7.45
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.0616	0.0132	0.071	4.6
0°	0.163	0.0129	0.097	12.63
2°	0.234	0.0146	0.116	16.02
4°	0.313	0.0181	0.134	17.29
6°	0.391	0.0225	0.154	17.37
8°	0.47	0.0275	0.177	17.09

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 26 date: 10-1972

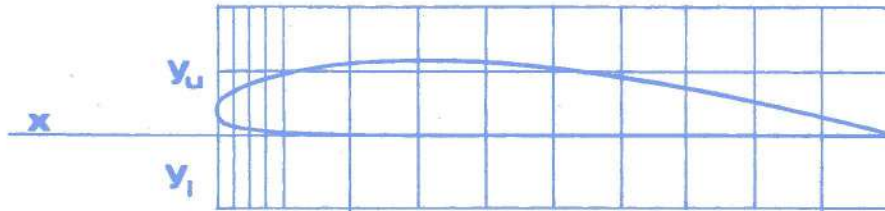


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

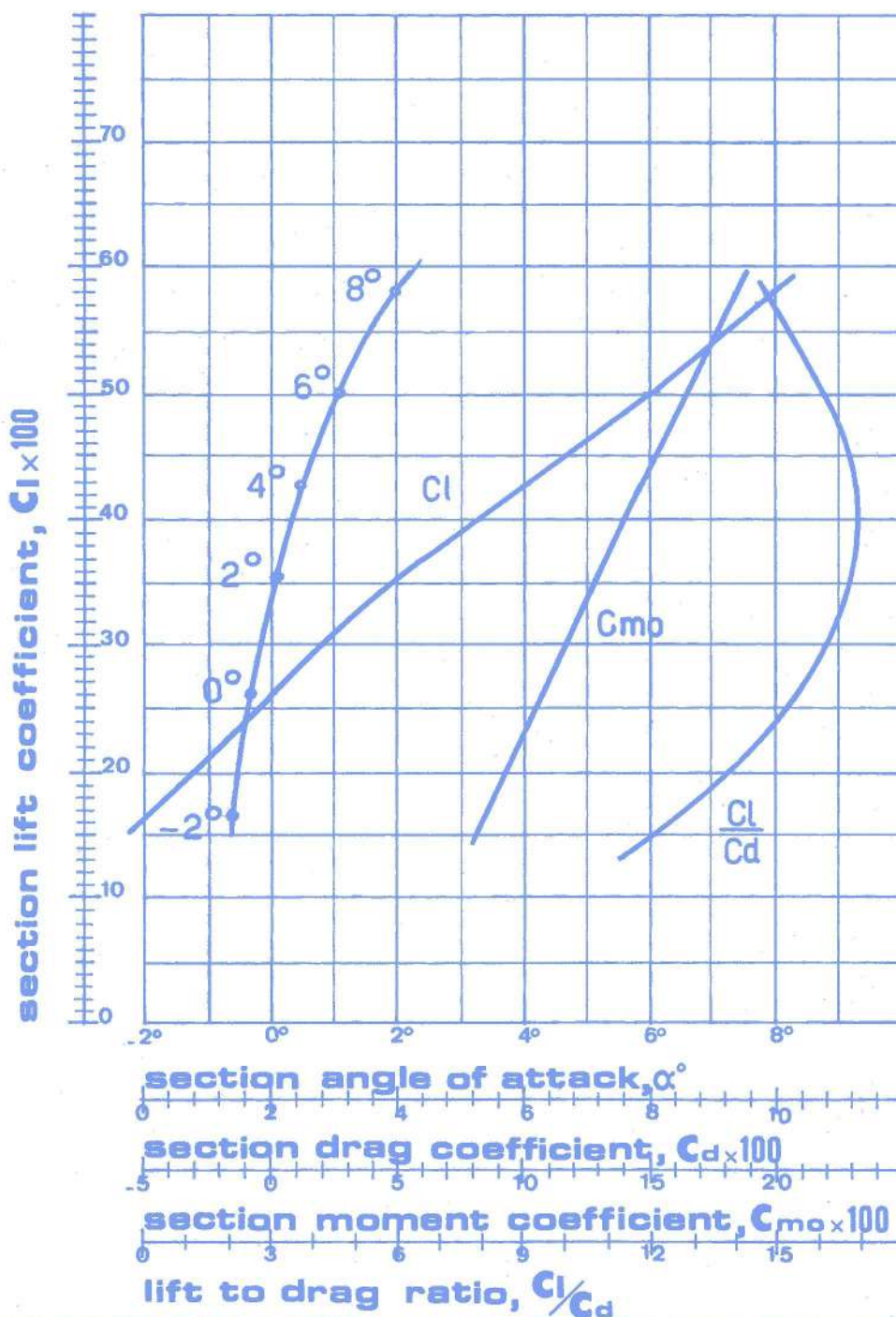
SECTION TESTED: CLARK Y



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	3,6	5,38	6,43	7,83	8,79	9,56	11,32	11,68	11,37	10,49	9,13	7,34	5,21	2,79	0,12
y_l	3,6	1,86	1,42	0,91	0,59	0,39	0,01	0	0	0	0	0	0	0	0

TEST CONDITIONS

air temperature, deg.°C: 14°
 air velocity, m/sec: 7,14
 reynolds number: 58000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l / C_d
-2°	0.165	0.0132	0.0836	12.5
0°	0.26	0.017	0.106	15.29
2°	0.354	0.0213	0.128	16.61
4°	0.427	0.0252	0.145	16.94
6°	0.502	0.0312	0.164	16.08
8°	0.581	0.0399	0.184	14.56

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 22 date: 10-1972

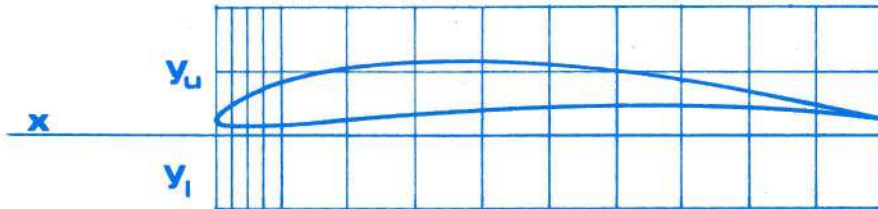


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

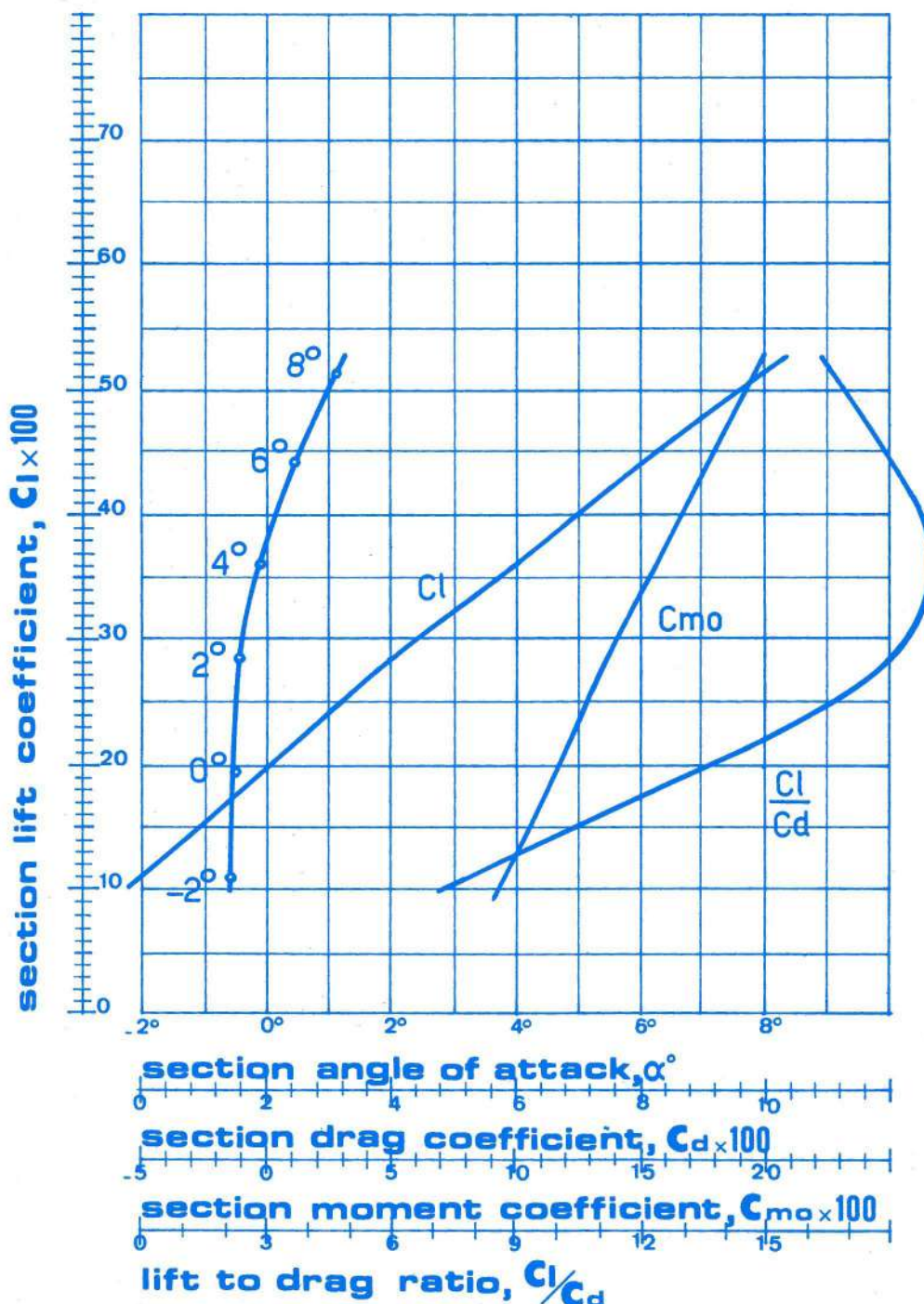
SECTION TESTED: EPPLER 385



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	2	3,4	4,6	6	7,1	8	10,2	11,4	11,8	11,2	10,1	8,5	6,6	4,6	2
y_l	2	1,2	1,2	1,2	1,3	1,4	2,3	3,1	3,6	4,1	4,4	4,4	4,1	3,5	2

TEST CONDITIONS

air temperature, deg.°C: 12°
 air velocity, m/sec: 7,43
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.11	0.014	0.094	7.85
0°	0.197	0.015	0.116	13.13
2°	0.283	0.0157	0.137	18
4°	0.36	0.0189	0.156	19.04
6°	0.44	0.0243	0.178	18.1
8°	0.514	0.0311	0.196	16.52

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 28 date: 10-1972

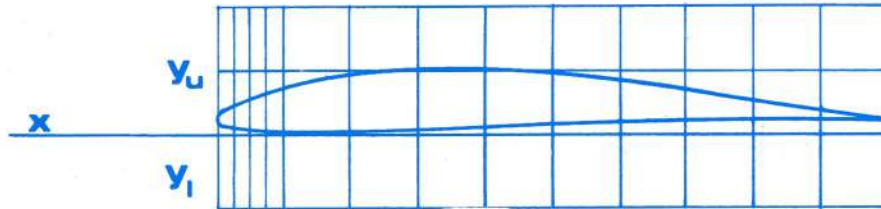


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low speed wind tunnel
 experimenter: enrico gallazzi

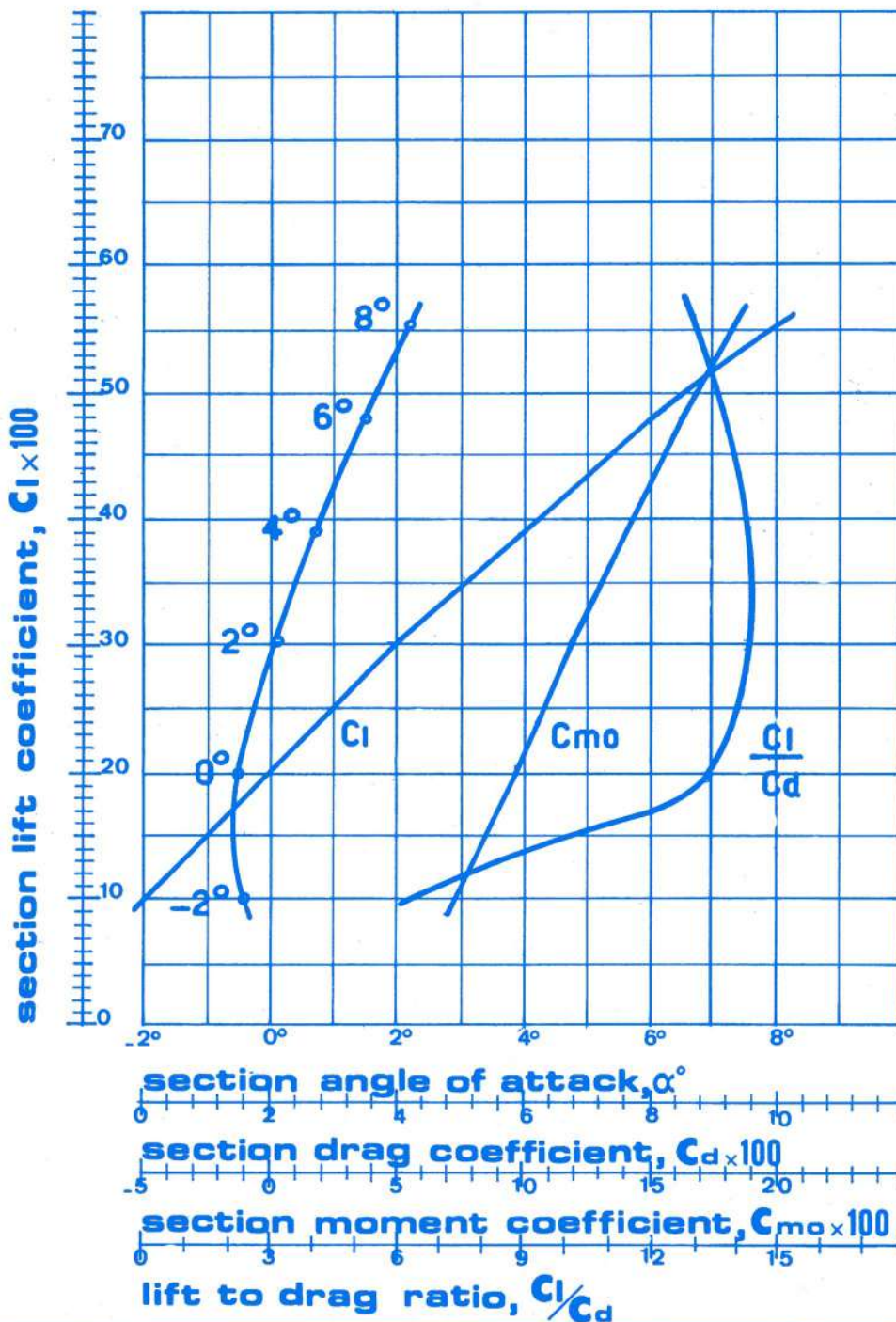
SECTION TESTED: EPPLER 387



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	2	3,5	4,5	5,6	6,5	7,2	9,2	10,1	10,2	9,5	8,2	6,8	5,2	3,6	2
y_l	2	1,2	0,9	0,6	0,5	0,5	0,7	1	1,4	1,7	2	2,2	2,3	2,3	2

TEST CONDITIONS

air temperature, deg.°C: 14°
 air velocity, m/sec: 7.16
 reynolds number: 58000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l / C_d
-2°	0.1	0.016	0.073	6.25
0°	0.2	0.015	0.097	13.3
2°	0.302	0.021	0.119	14.38
4°	0.39	0.0271	0.14	14.39
6°	0.479	0.0349	0.162	13.72
8°	0.554	0.0425	0.182	13

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 17 date: 10-1972

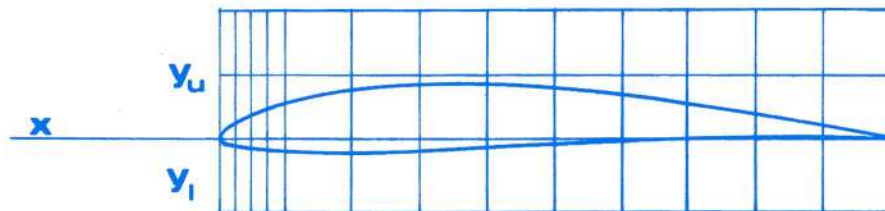


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

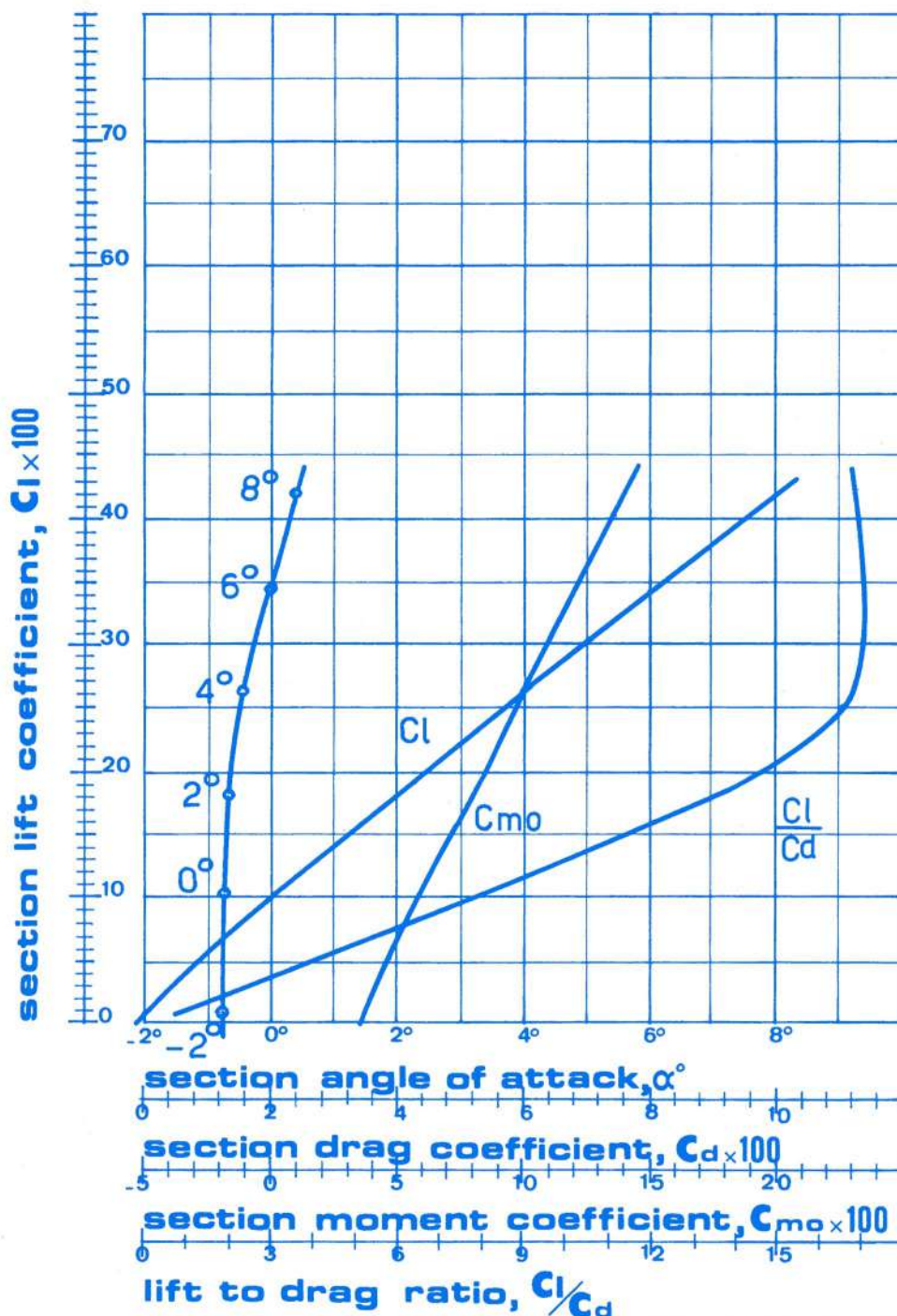
SECTION TESTED: EPPLER 392



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	1,53	2,5	3,69	4,61	5,45	7,53	8,53	8,55	8,07	6,9	5,38	3,69	1,92	0
y_l	0	-0,9	-1,23	-1,57	-1,8	-1,88	-1,92	-1,69	-1,23	-0,84	-0,38	0	0,19	0,26	0

TEST CONDITIONS

air temperature, deg.°C: 13°
 air velocity, m/sec: 7.47
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l / C_d
-2°	0.0099	0.0122	0.0366	0.81
0°	0.101	0.0125	0.0586	8.08
2°	0.181	0.0131	0.0808	13.81
4°	0.263	0.0154	0.099	17.07
6°	0.344	0.02	0.119	17.2
8°	0.42	0.0247	0.14	17

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 25 date: 10-1972



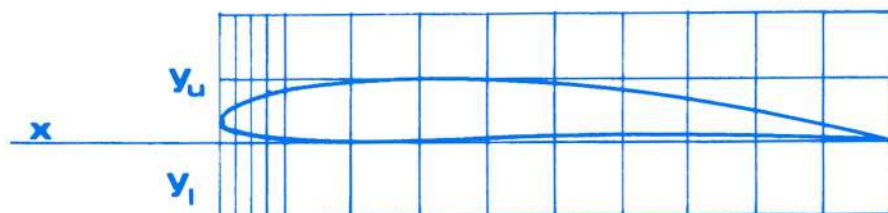
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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

SECTION TESTED:

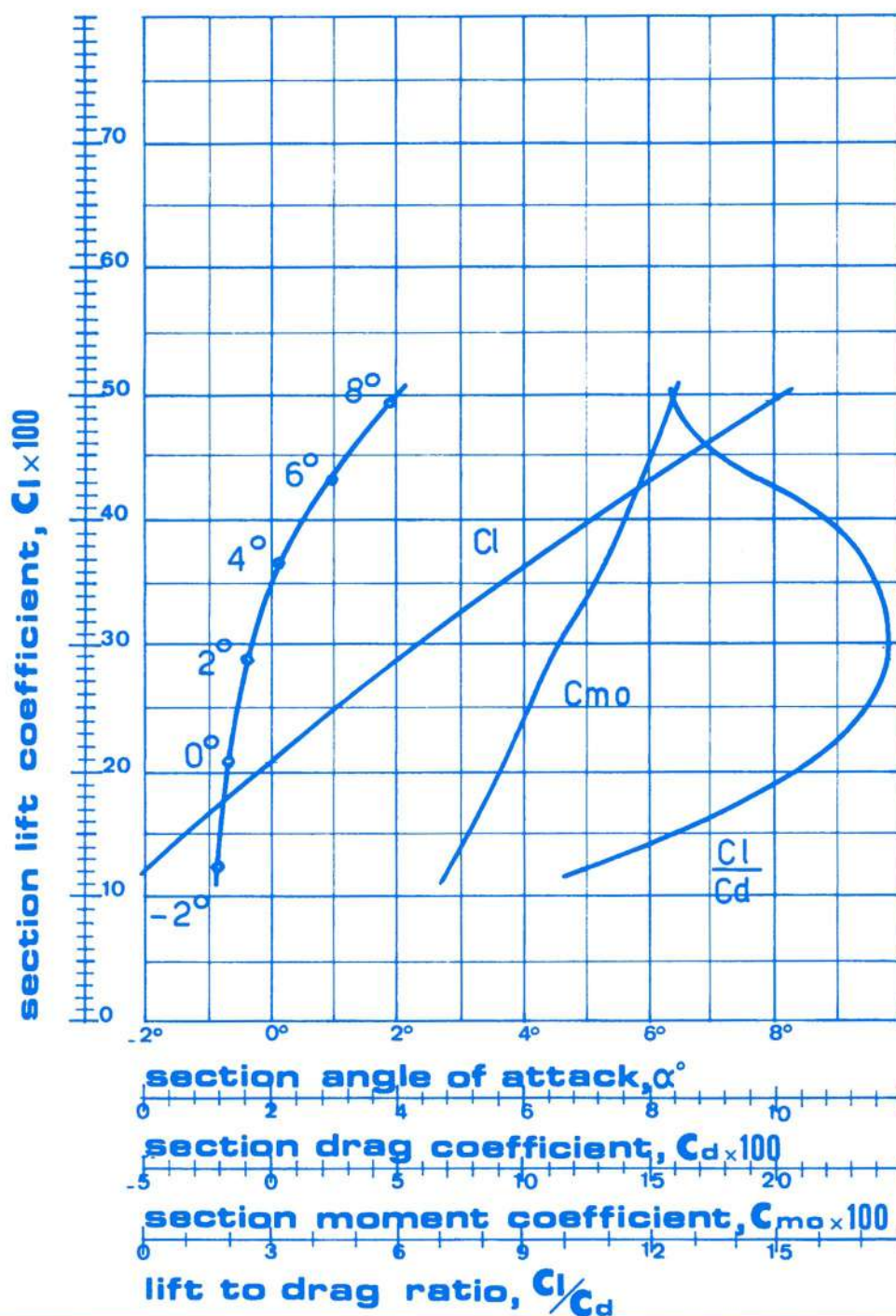
FUKUDA 10



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	3,69		5,75	6,74	7,59	8,07	9,61	10,07	9,69	8,92	7,61	6,15	4,46	2,38	0,16
y_l	3,69		2,19	1,56	1,08	0,76	0	0,15	0,53	0,84	1,12	1,12	1,12	0,7	0

TEST CONDITIONS

air temperature, deg.°C: 7°
 air velocity, m/sec: 7,41
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.121	0.0114	0.0708	10.61
0°	0.208	0.0131	0.0928	15.87
2°	0.285	0.0161	0.11	17.7
4°	0.365	0.0213	0.133	17.13
6°	0.431	0.0297	0.146	14.51
8°	0.495	0.0392	0.159	12.62

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 33 date: 11-1972



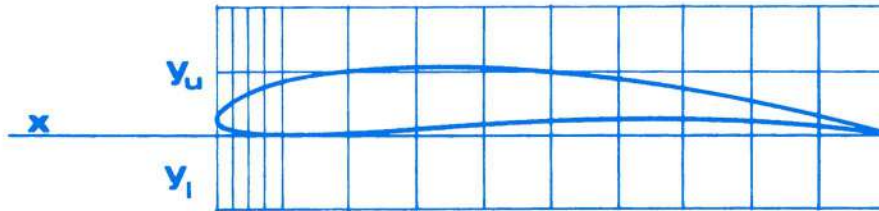
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Sezione Sperimentale

MEG

low speed wind tunnel
 experimenter: enrico gallazzi

SECTION TESTED:

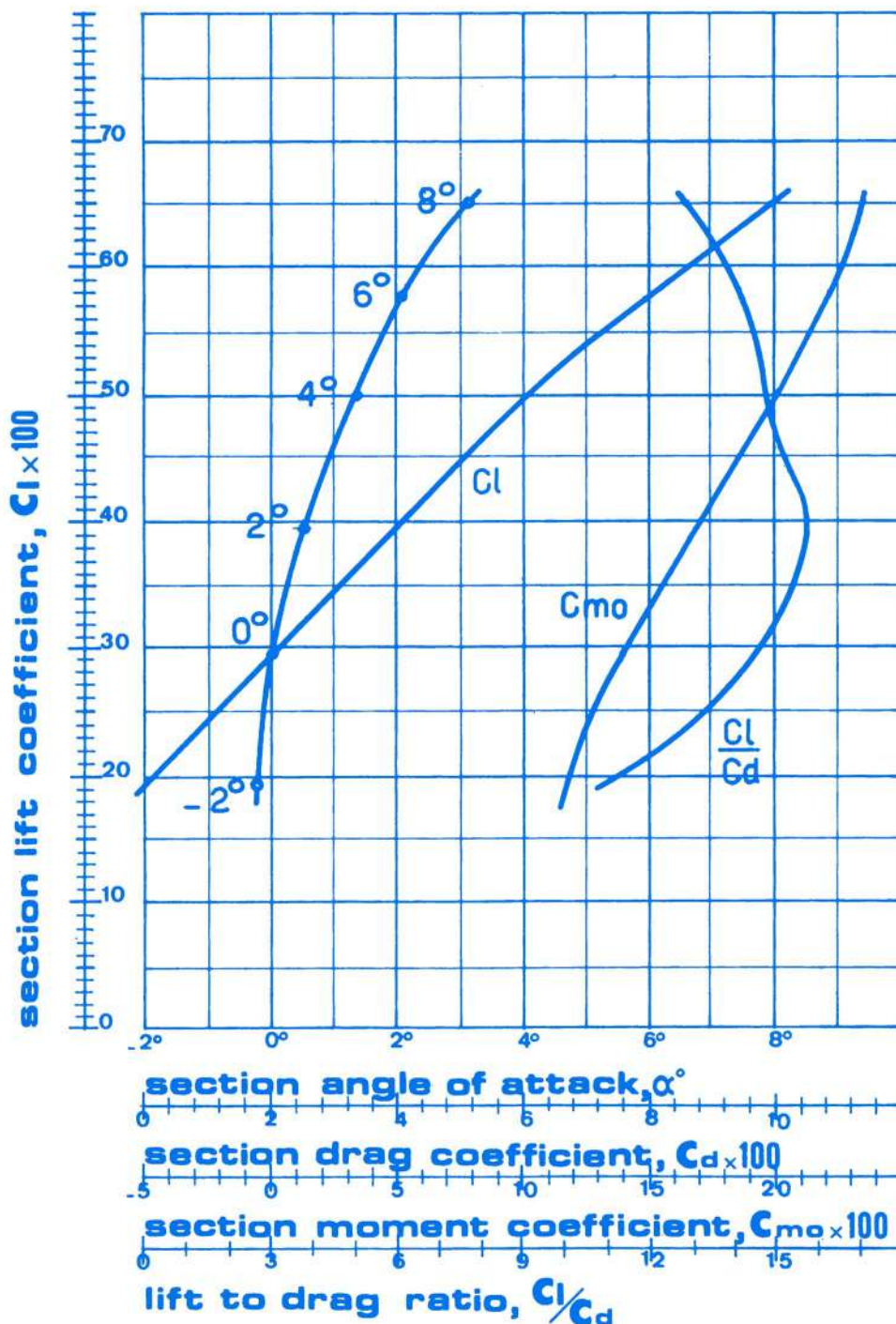
GÖTT 496



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	2.5	4.45	5.35	6.65	7.65	8.45	10.25	11	10.95	10.2	8.95	7.25	5.2	2.85	0
y_l	2.5	1.1	0.65	0.25	0	0	0.35	1.05	1.75	2.3	2.5	2.5	2	1.25	0

TEST CONDITIONS

air temperature, deg.°C: 15°
 air velocity, m/sec : 7.13
 reynolds number : 58000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l / C_d
-2°	0.194	0.0176	0.118	11.02
0°	0.294	0.0205	0.141	14.34
2°	0.394	0.025	0.17	15.76
4°	0.5	0.0338	0.202	14.79
6°	0.577	0.0408	0.221	14.14
8°	0.651	0.051	0.234	12.76

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 16 date: 10-1972



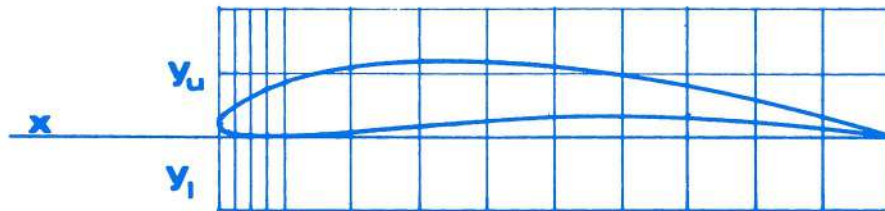
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MEG

low speed wind tunnel
experimenter: enrico gallazzi

SECTION TESTED:

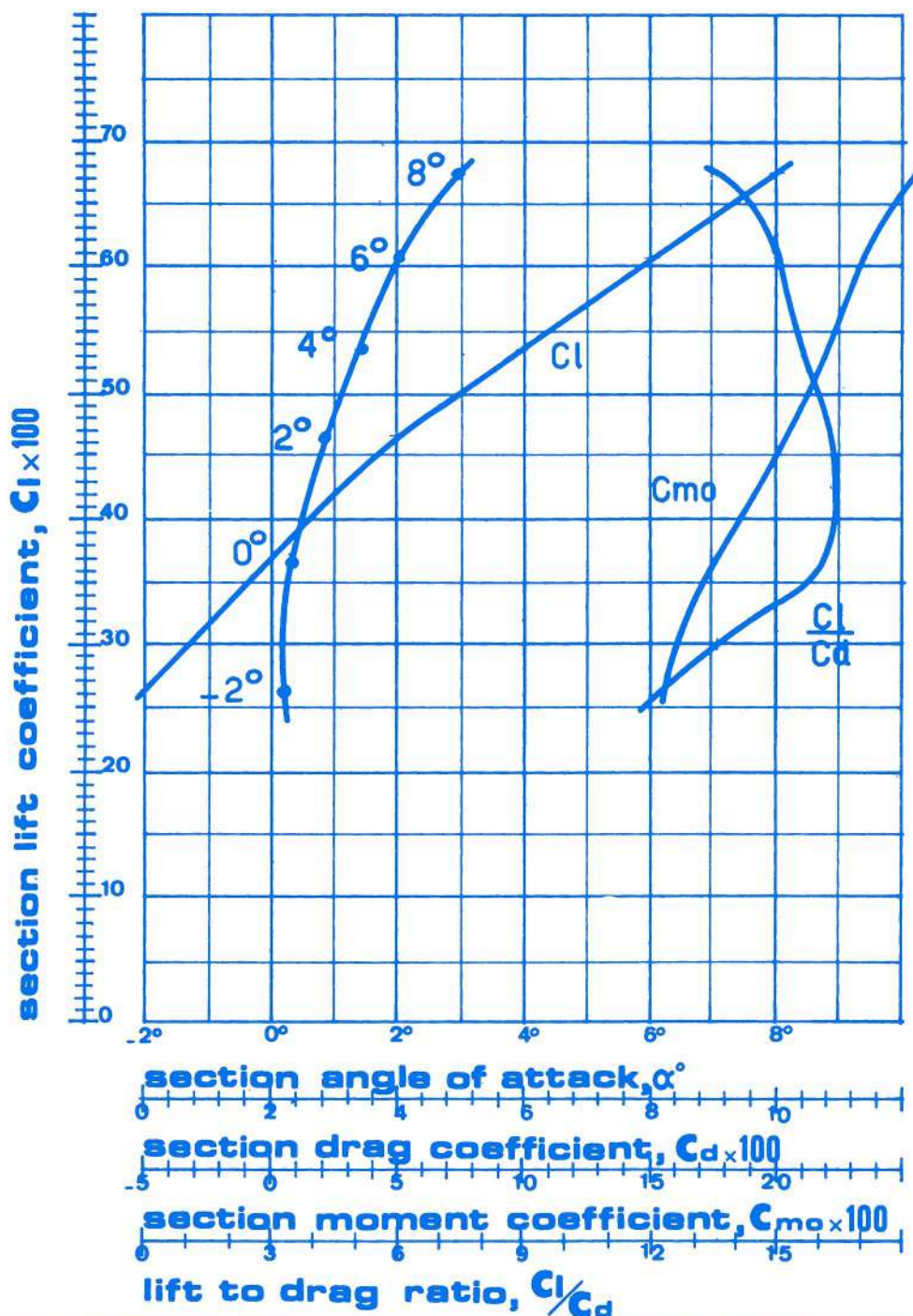
GÖTT 500



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	2,05	4,15	5	6,3	7,35	8,2	10,5	11,6	11,65	11,05	9,85	8,1	5,85	3,1	0
y_l	2,05	0,85	0,45	0,1	0	0,05	0,7	1,6	2,4	3	3,3	3,15	2,45	1,45	0

**TEST
CONDITIONS**

air temperature, deg.°C: 14°
air velocity, m/sec: 7,1
reynolds number: 57000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.263	0.0218	0.155	12.06
0°	0.368	0.0229	0.176	16.06
2°	0.465	0.0286	0.203	16.25
4°	0.537	0.0346	0.22	15.52
6°	0.607	0.0404	0.234	15.02
8°	0.674	0.0502	0.253	13.42

REMARKS

size of model
with endplates: 600x120mm
model aspect ratio: 5
detail of endplates:



test n: 18 date: 10-1972

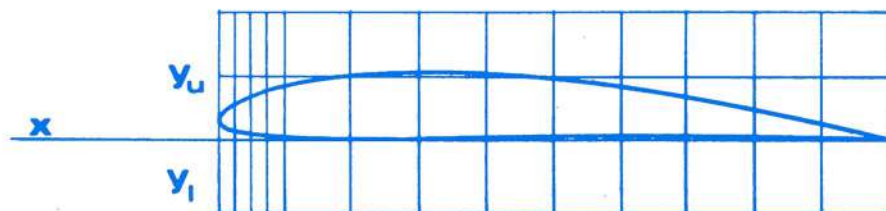


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

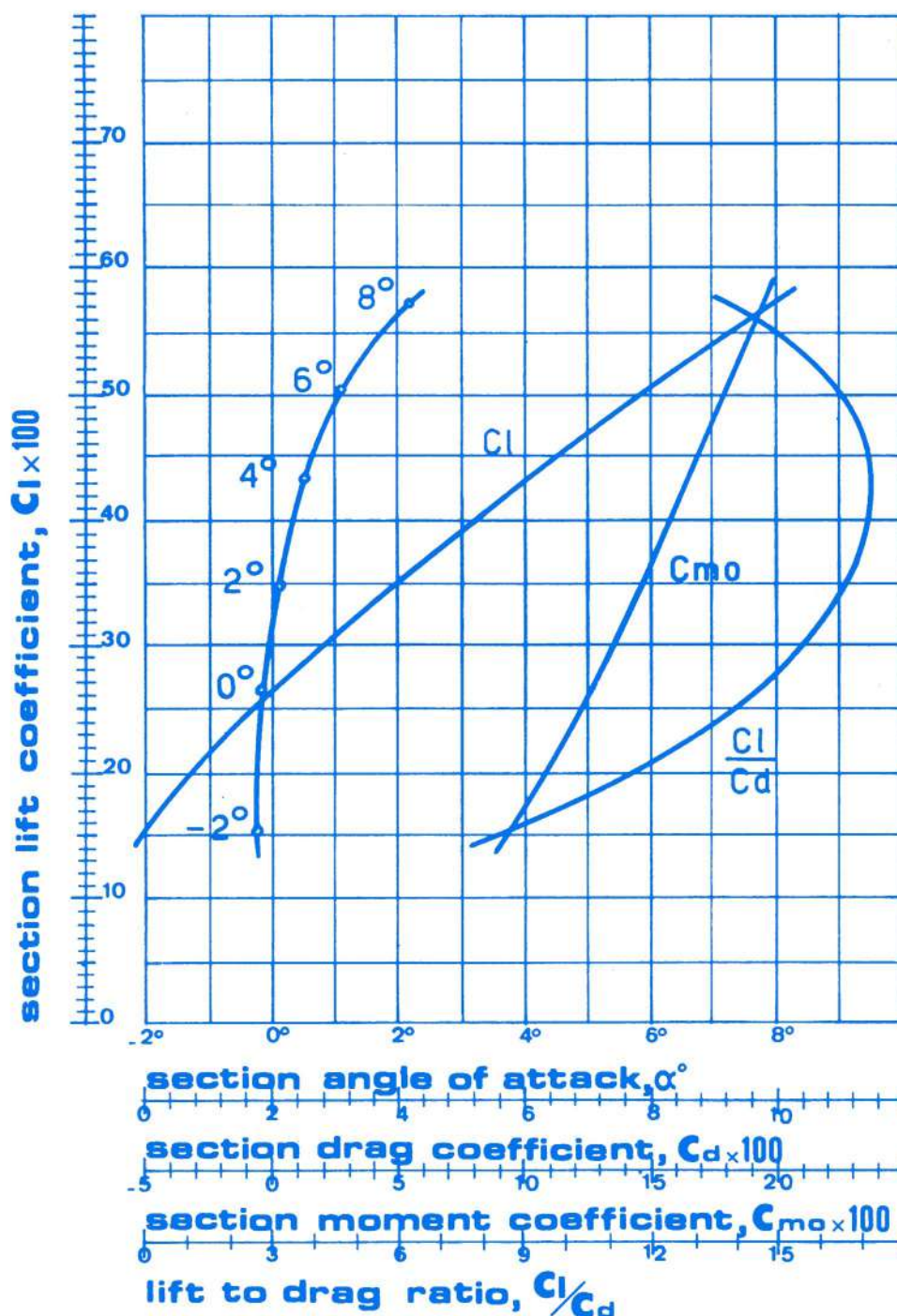
SECTION TESTED: GÖTT 546



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	2.9	4.95	5.65	6.75	7.55	8.2	9.8	10.4	10.25	9.55	8.33	6.8	4.8	2.65	0
y_l	2.9	1.7	1.3	0.9	0.65	0.45	0	0	0.2	0.5	0.7	0.75	0.65	0.45	0

TEST CONDITIONS

air temperature, deg.°C: 14°
 air velocity, m/sec: 7.1
 reynolds number: 57000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l / C_d
-2°	0.152	0.0176	0.095	8.63
0°	0.264	0.018	0.127	14.6
2°	0.349	0.0211	0.145	16.54
4°	0.433	0.0251	0.164	17.25
6°	0.504	0.0309	0.18	16.31
8°	0.576	0.0421	0.194	13.68

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 19 date: 10-1972

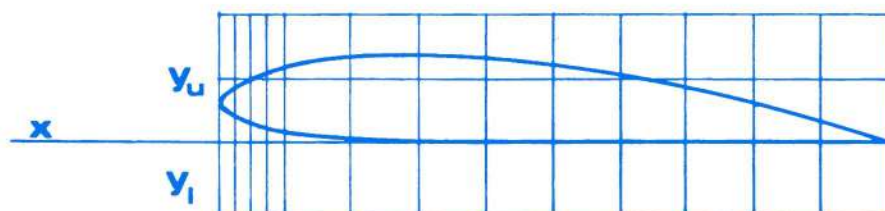


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

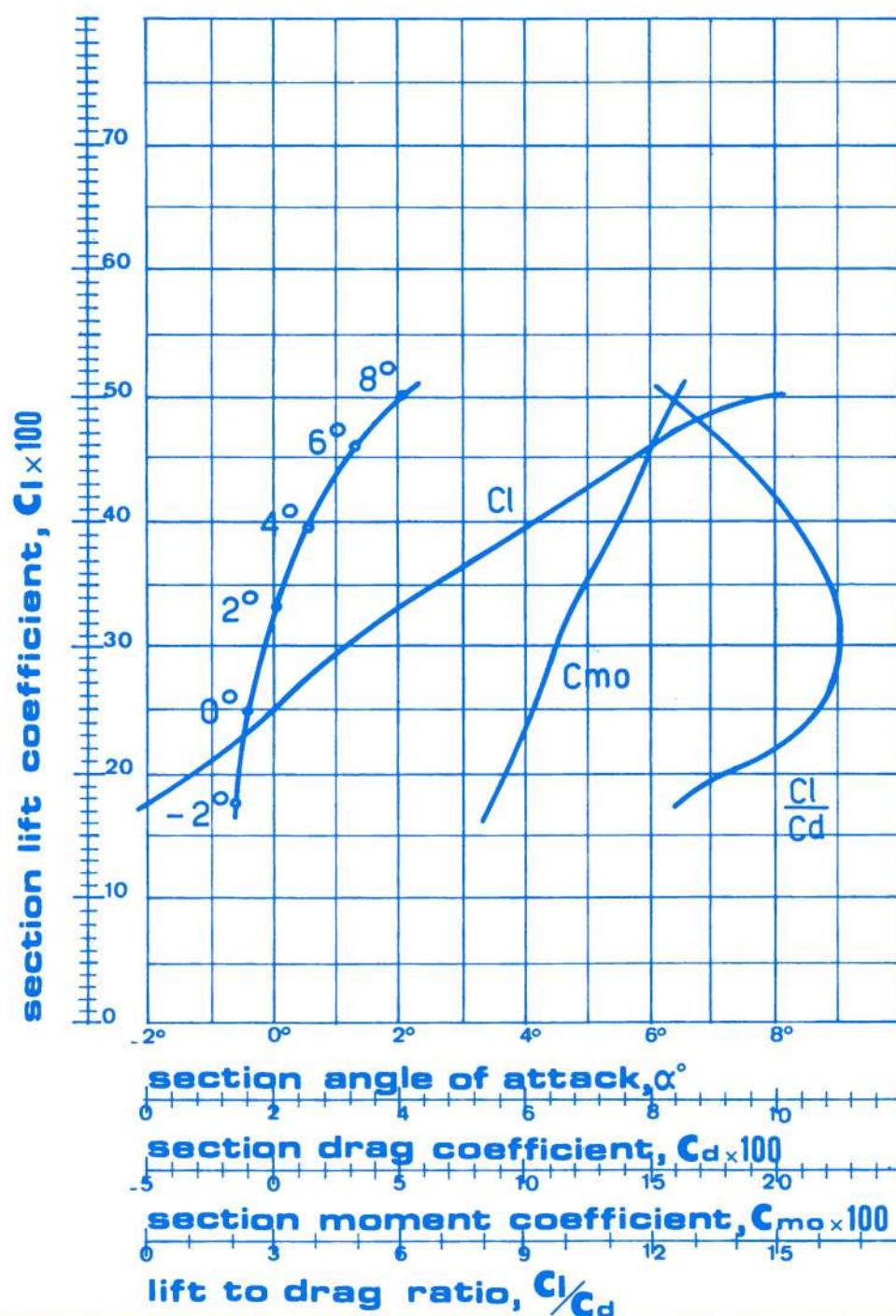
SECTION TESTED: HILL SR 2



x	0	1.25	2.5	5	7.5	10	20	30	40	50	60	70	80	90	100
y_u	6.4	8	8.8	10.1	11	11.6	13.3	13.7	13.3	12.2		8.4	5.8	3.1	0
y_l	6.4	4.9	4.1	3	2.2	1.5	0.4	0.1	0	0		0	0	0	0

TEST CONDITIONS

air temperature, deg.°C: 8°
 air velocity, m/sec: 7.42
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l/C_d
-2°	0.175	0.0138	0.0869	12.68
0°	0.248	0.0155	0.103	16
2°	0.333	0.0201	0.118	16.56
4°	0.396	0.0253	0.138	15.65
6°	0.458	0.033	0.15	13.87
8°	0.506	0.0407	0.16	12.43

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 38 date: 12-1972



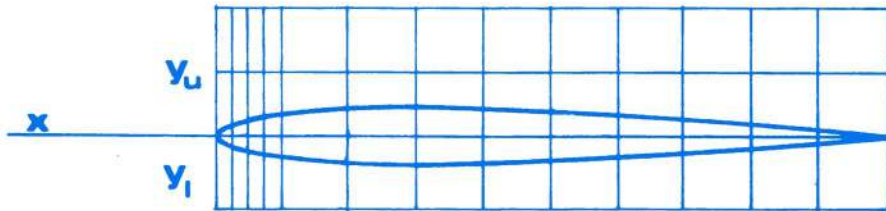
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low speed wind tunnel

experimenter: enrico gallazzi

SECTION TESTED: NACA 0009



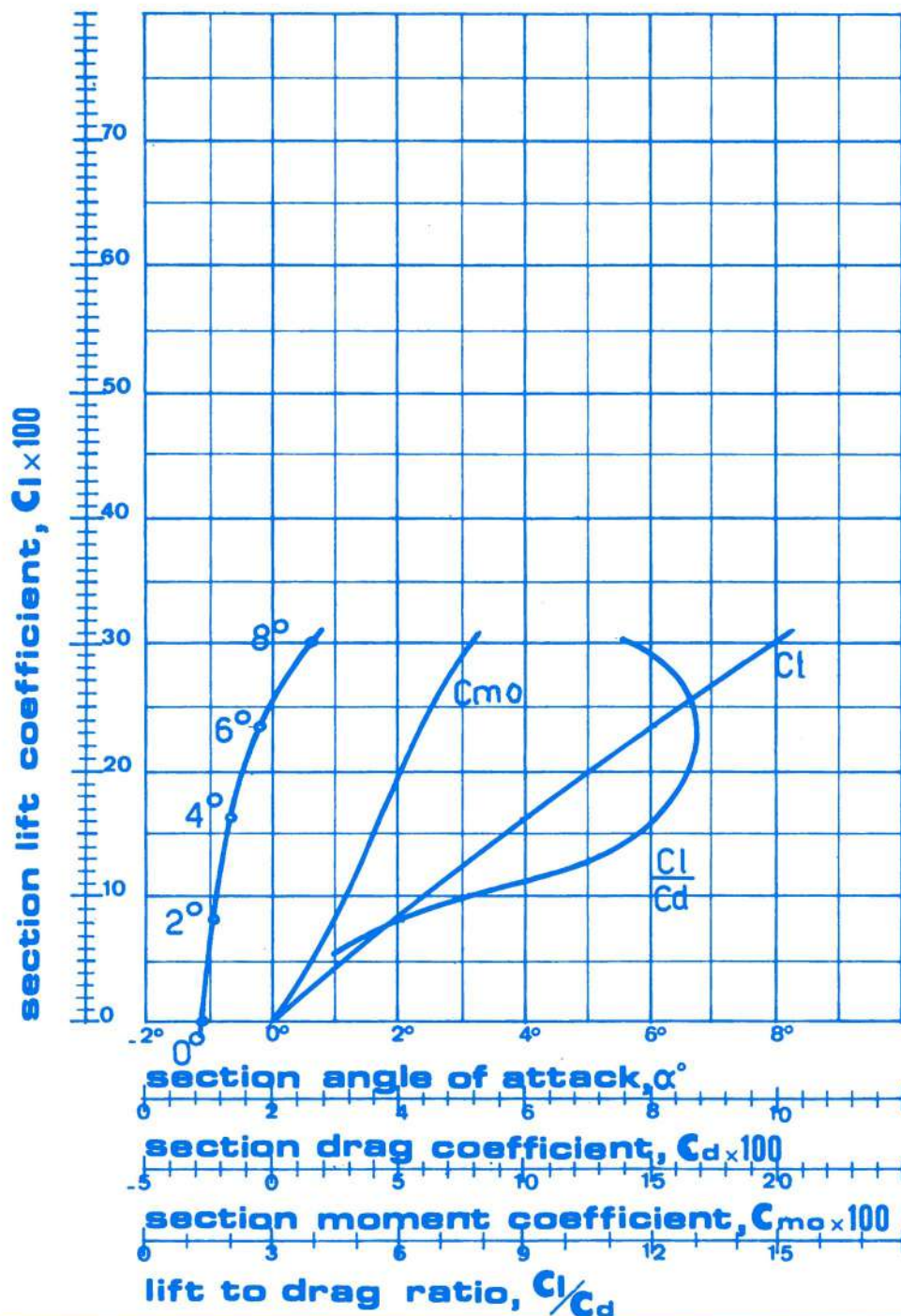
x	0	1.25	2.5	5	7.5	10	20	30	40	50	60	70	80	90	100
y_u	0	1.42	1.96	2.66	3.15	3.51	4.3	4.5	4.35	3.97	3.42	2.74	1.96	1.08	0
y_l	0	-1.42	-1.96	-2.66	-3.15	-3.51	-4.3	-4.5	-4.35	-3.97	-3.42	-2.74	-1.96	-1.08	0

TEST CONDITIONS

air temperature, deg.°C: 12°

air velocity, m/sec: 7.43

reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°				
0°	0	0.0092	0	
2°	0.08	0.0107	0.0239	7.48
4°	0.163	0.0135	0.0427	12.07
6°	0.234	0.018	0.0597	13
8°	0.3	0.0261	0.0798	11.49

REMARKS

size of model with endplates: 600x120mm

model aspect ratio: 5

detail of endplates:



test n: 27

date: 10-1972

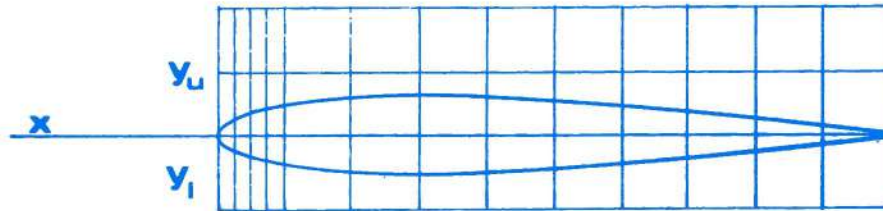


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low speed wind tunnel
 experimenter: enrico gallazzi

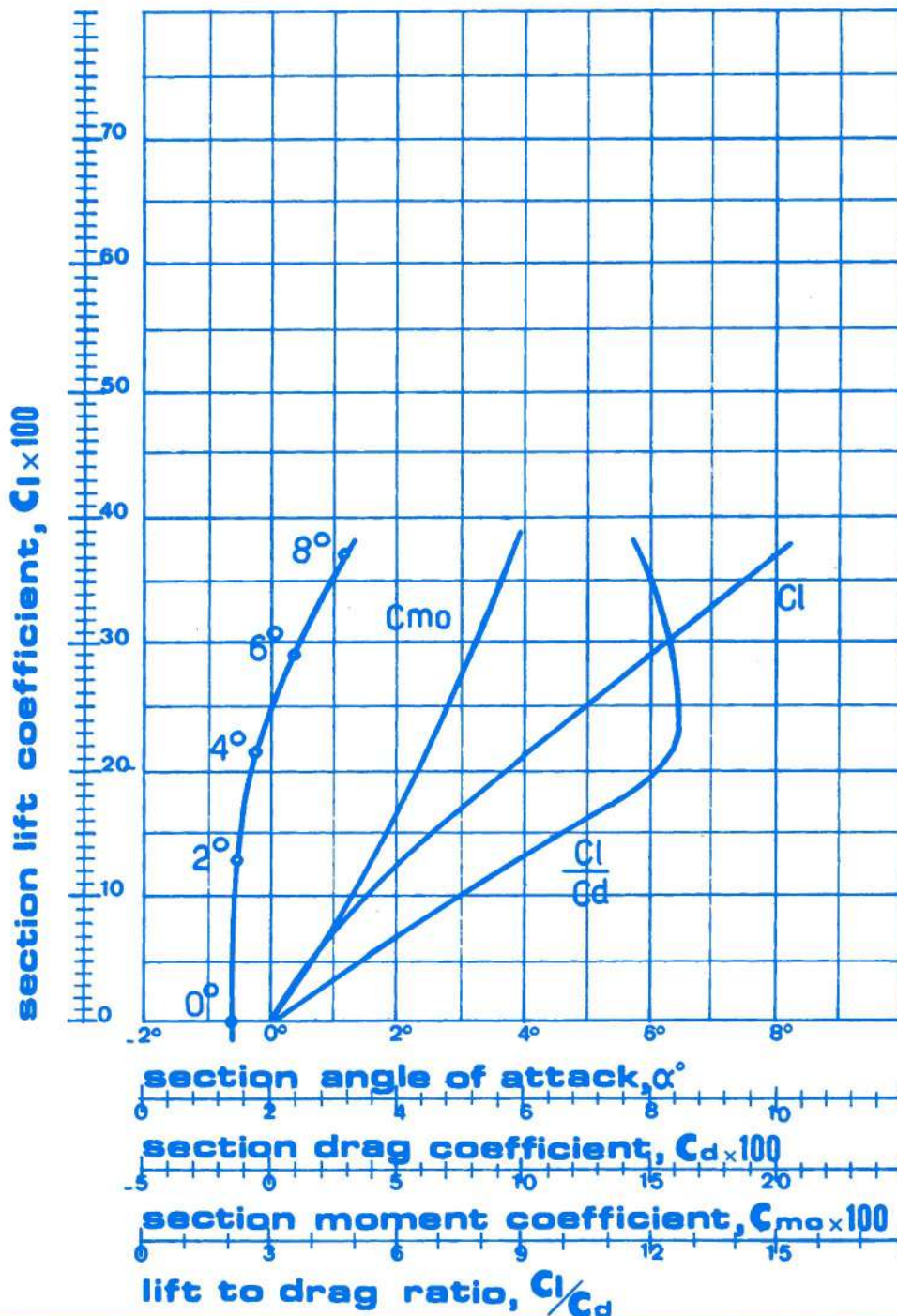
SECTION TESTED: NACA 0012



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	1.89	2.61	3.55	4.2	4.68	5.73	6	5.8	5.29	4.56	3.66	2.62	1.44	0
y_l	0	-1.89	-2.61	-3.55	-4.2	-4.68	-5.73	-6	-5.8	-5.29	-4.56	-3.66	-2.62	-1.44	0

TEST CONDITIONS

air temperature, deg.°C: 16°
 air velocity, m/sec: 7
 reynolds number: 56000



TEST RESULTS

section of angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°				
0°	0	0.0138	0	
2°	0.129	0.0145	0.0405	8.89
4°	0.214	0.017	0.0619	12.58
6°	0.29	0.0232	0.0803	12.5
8°	0.37	0.0311	0.097	11.89

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 20 date: 10-1972



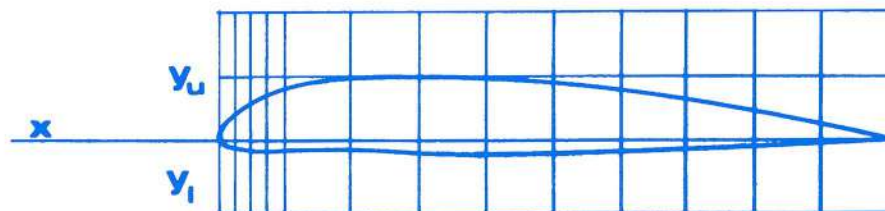
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low speed wind tunnel
 experimenter: enrico gallazzi

SECTION TESTED:

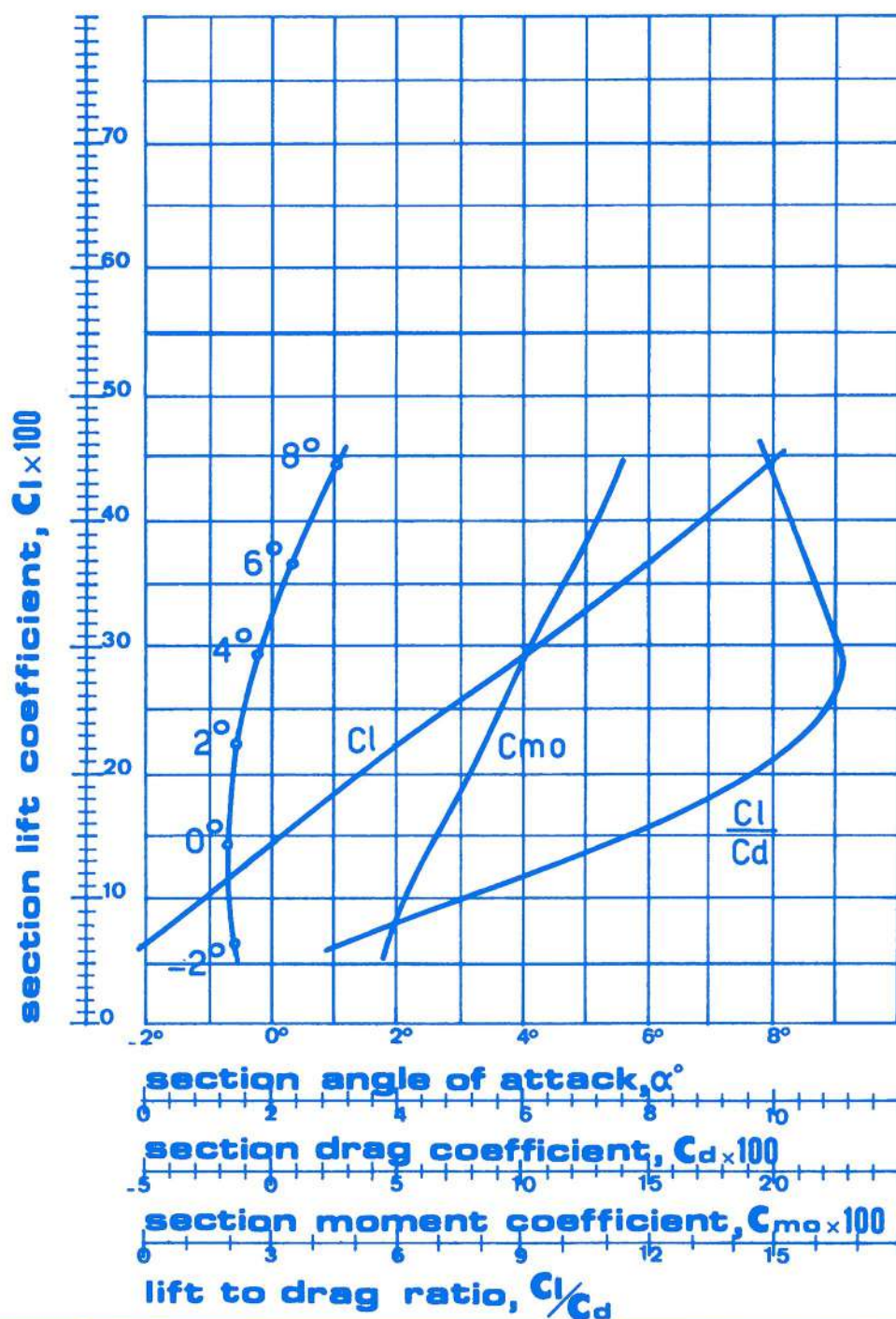
NACA 4212



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	3,04	4,13	5,75	6,96	7,9	9,74	9,94	9,56	8,75	7,59	6,13	4,39	2,41	0
y_l	0	-1,07	-1,41	-1,63	-1,66	-1,61	-1,74	-2,06	-2,05	-1,85	-1,55	-1,21	-0,85	-0,5	0

TEST CONDITIONS

air temperature, deg.°C: 11°
 air velocity, m/sec : 7,37
 reynolds number : 59000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l/C_d
-2°	0,066	0,0142	0,0477	4,68
0°	0,144	0,0131	0,0639	10,99
2°	0,222	0,0145	0,0856	15,31
4°	0,293	0,0177	0,101	16,55
6°	0,369	0,0233	0,12	15,83
8°	0,447	0,0302	0,139	14,8

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 30 date: 11-1972

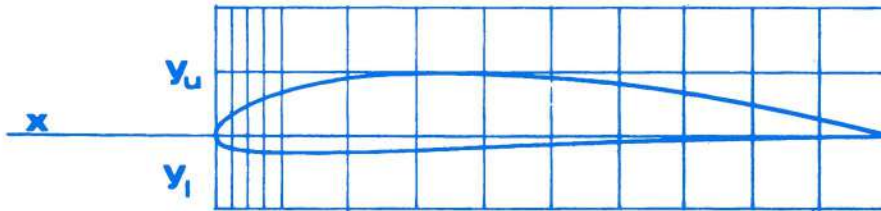


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

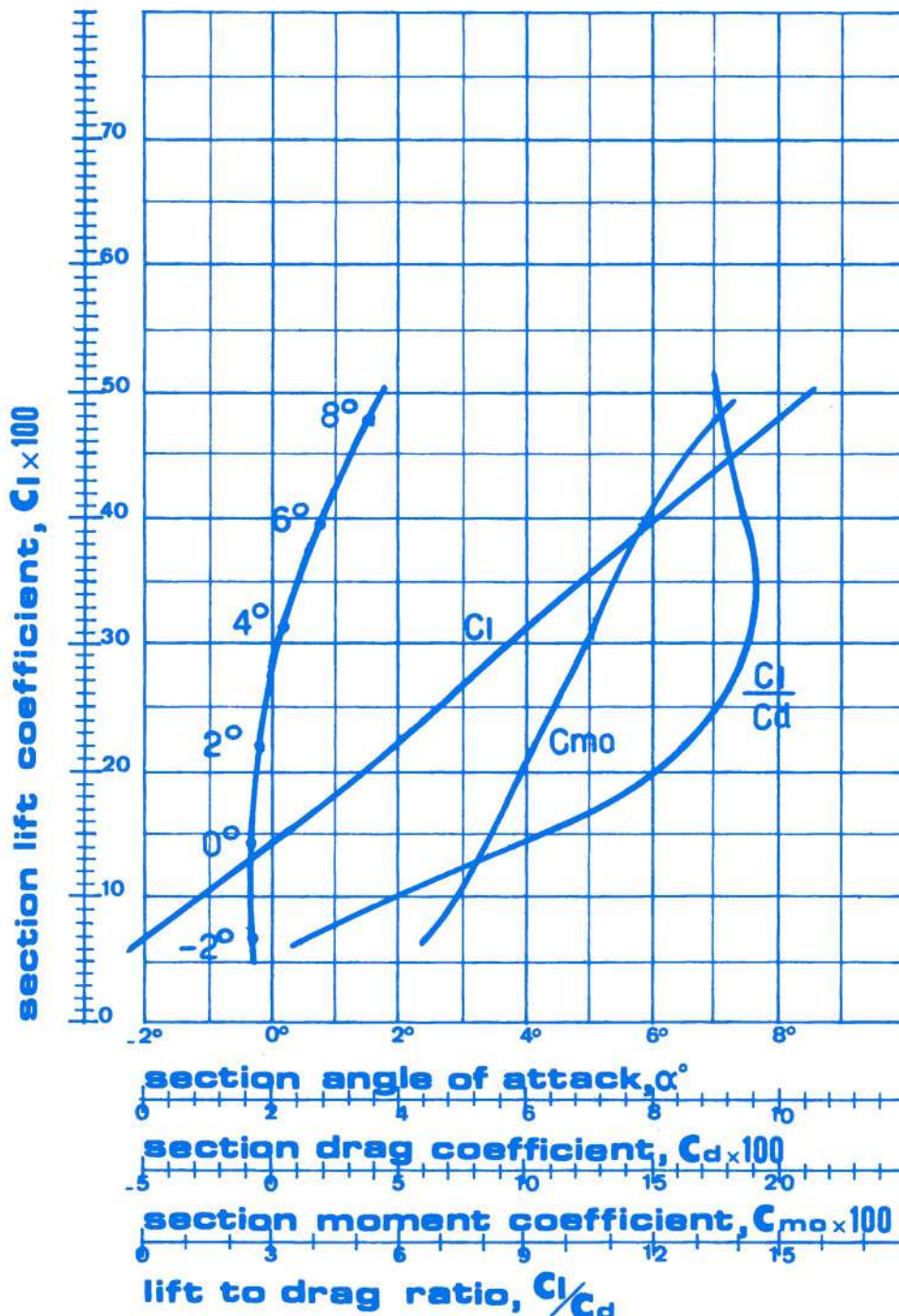
SECTION TESTED: NACA 4412



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	2,44	3,39	4,73	5,76	6,59	8,8	9,76	9,8	9,19	8,14	6,69	4,89	2,71	0
y_l	0	-1,43	-1,95	-2,44	-2,74	-2,86	-2,74	-2,26	-1,8	-1,4	-1	-0,65	-0,39	-0,22	0

TEST CONDITIONS

air temperature, deg.°C: 15°
 air velocity, m/sec: 7.12
 reynolds number: 57000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.0645	0.0173	0.06	3.72
0°	0.146	0.0165	0.085	8.84
2°	0.217	0.0183	0.102	12.73
4°	0.314	0.022	0.127	14.27
6°	0.394	0.0278	0.147	14.17
8°	0.478	0.035	0.176	13.65

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 15 date: 10-1972



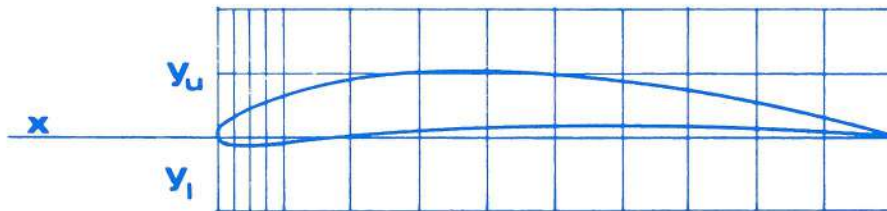
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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

SECTION TESTED:

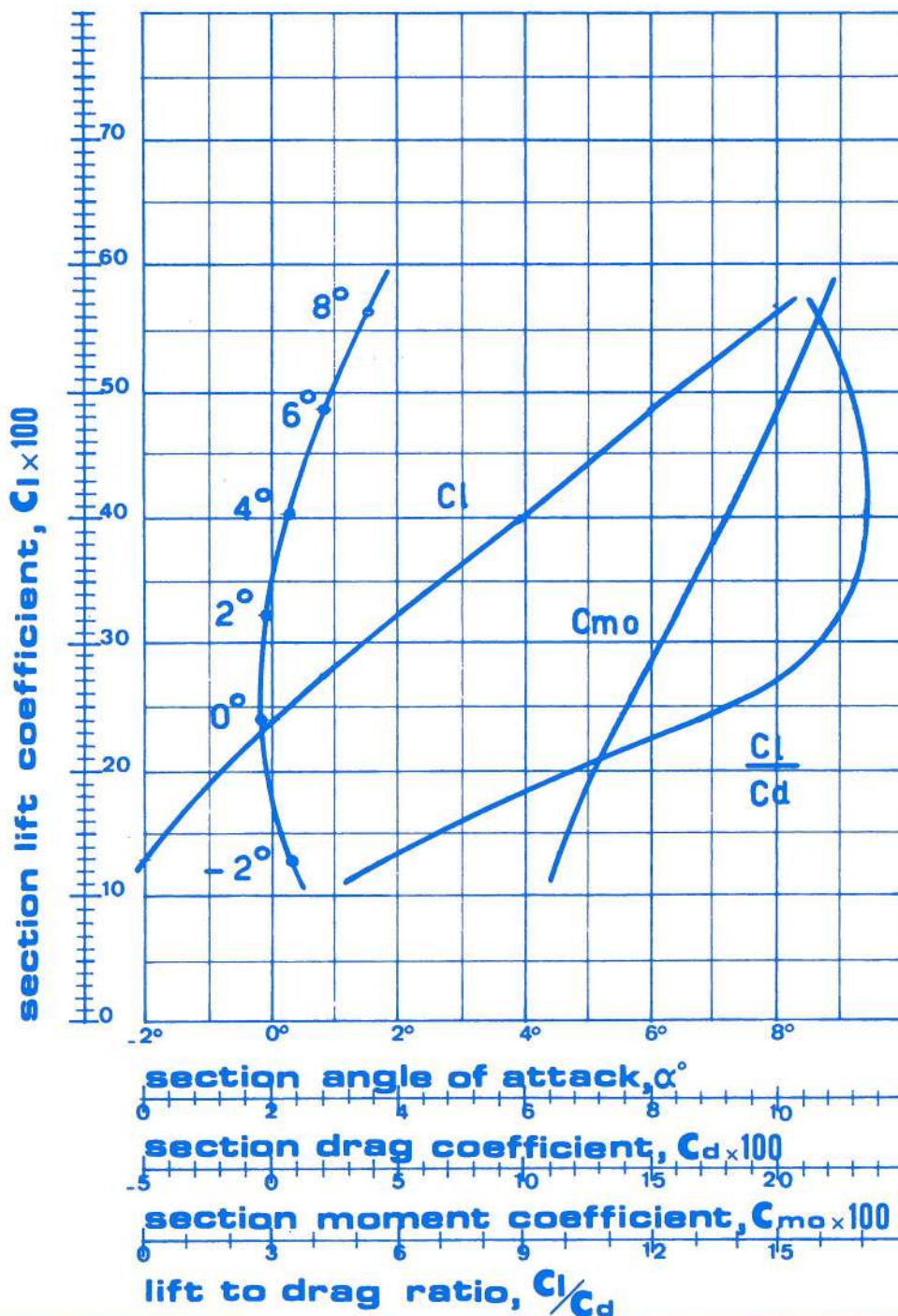
NACA 6409



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	2.06	2.96	4.3	5.42	6.31	8.88	10.13	10.35	9.81	8.78	7.28	5.34	2.95	0
y_l	0	-0.88	-1.11	-1.18	-1.08	-0.88	0.17	1.12	1.65	1.86	1.92	1.76	1.36	0.74	0

TEST CONDITIONS

air temperature, deg.°C: 14°
 air velocity, m/sec: 6.23
 reynolds number: 50000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{mo}	C_l/C_d
-2°	0.129	0.023	0.113	5.6
0°	0.24	0.0183	0.139	13.11
2°	0.323	0.0195	0.161	16.56
4°	0.405	0.023	0.181	17.06
6°	0.485	0.0286	0.202	16.95
8°	0.562	0.0352	0.217	15.96

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 21 | date: 10-1972

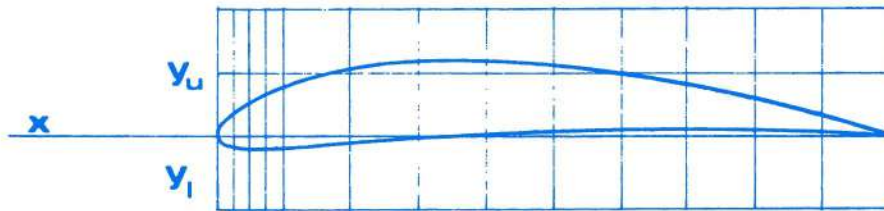


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MEG

low speed wind tunnel
 experimenter: enrico gallazzi

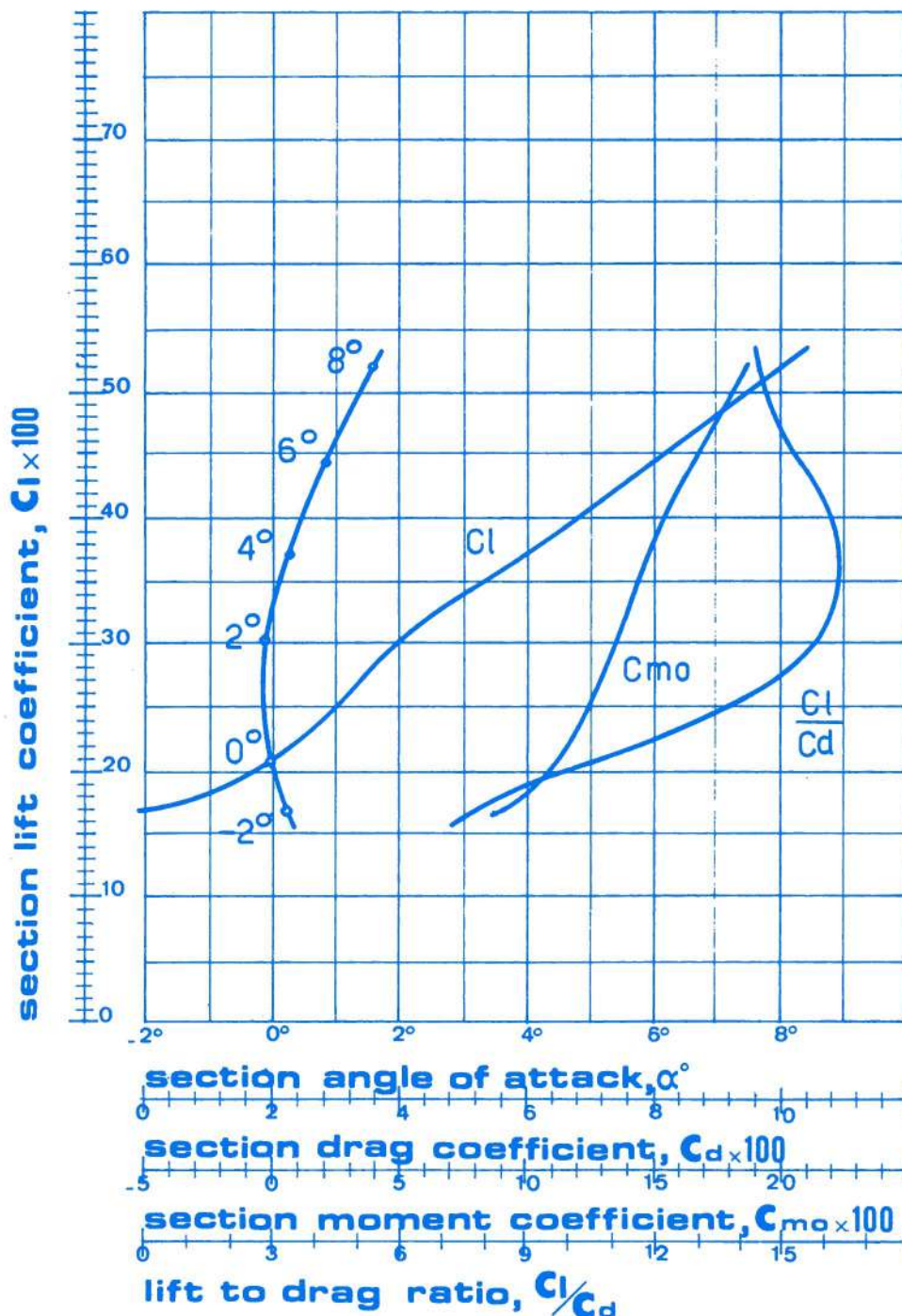
SECTION TESTED: NACA 6412



x	0	1,25	2,5	5	7,5	10	20	30	40	50	60	70	80	90	100
y_u	0	2.73	3.8	5.36	6.57	7.58	10.34	11.65	11.80	11.16	9.95	8.23	6.03	3.33	0.12
y_l	0	-1.23	-1.64	-1.99	-2.05	-1.99	-1.25	-0.38	0.2	0.55	0.78	0.85	0.73	0.39	0.12

TEST CONDITIONS

air temperature, deg.°C: 15°
 air velocity, m/sec: 7.5
 reynolds number: 60000



TEST RESULTS

section angle of attack, α°	coefficients			
	C_l	C_d	C_{m0}	C_l/C_d
-2°	0.17	0.022	0.088	7.72
0°	0.207	0.0198	0.11	10.45
2°	0.303	0.0191	0.135	15.86
4°	0.372	0.0228	0.147	16.31
6°	0.444	0.0289	0.167	15.36
8°	0.518	0.0359	0.186	14.42

REMARKS

size of model with endplates: 600x120mm
 model aspect ratio: 5
 detail of endplates:



test n: 23 date: 10-1972